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NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

I. Dr. Schiebler's Calcimeter.

The almost daily use, for some years, of Dr. Schiebler's expeditious instrument for the estimation of carbonic acid in carbonates, and the invariably consistent results obtained, have made it quite a favourite with the author of these notes. Believing the instrument to be far too little known, he would seek to call attention to its value, especially to those who have the charge of sugar refineries, where the frequent estimation of calcic carbonate in animal charcoal is a desideratum.

With a little practice, twelve or fourteen estimations may easily be made in an hour; and these, if upon the same finely-powdered sample, will, with ordinary care, be found to agree almost absolutely. The saving of time by this process over the most expeditious of the ordinary gravimetric methods (which alone are applicable to substances like bone-char) will be found to be very great. Starting, in each case, with the sample in powder, the difference in time is such as easily to repay the first cost of the instrument by a few hours work. As the instrument is sold with a normal weight and tables of calculated results, no time is lost in after calculations. The volume of carbonic acid, and the temperature indicated by the instrument, are referred to the tables, where the percentage quantity of carbonic acid or calcic carbonate is at once found. One great advantage of such an expeditious method as this is that there is no temptation to be satisfied with first results, as a few minutes suffice to repeat the process. A general description of the instrument and process, in English, will be found in the last edition of "Fresenius" (Quantitative Part); but a perusal of the original German instructions will be found profitable.

In most freshly-burnt bone-chars, traces of sulphides are to be found. These, of course, vitiate the results obtained by Dr. Schiebler's instrument to a trifling extent; but the author has not found, over a wide experience (unless on one occasion), more than 0·5 per cent of the evolved gases to be hydric sulphide; so that, for all practical purposes, that may be entirely overlooked.

II. The Action of Finely-Divided Carbon on Solutions of the Chromates in Hydrochloric Acid.

On the occasion of finding excess of sulphides in a sample of bone-char, referred to above, an effort was made to oxidise the sulphur simultaneously with the evolution of the carbonic acid in the decomposing jar, but only with indifferent success. In the course of the experiments, undertaken with that end in view, a solution of potassic bichromate in strong hydrochloric acid was used. On decanting this solution from the little gutta-percha tube, upon the powdered charcoal in the decomposing jar, *instant* and *rapid* disengagement of chlorine resulted. It is well known that chlorine is *slowly* evolved from the solution referred to in the cold, *more rapidly* when heat is applied, and *still more rapidly* on the addition of alcohol and some other organic substances.* Animal charcoal, or bone-black, which produced the *instantaneous* effect referred to, is a very complex agent. Its peculiar action as a decolouriser is well known. It was, therefore, a question whether this was an action analogous to decolouration, or if it was due to the action of some individual substance present in the char. The various constituents were tried, one by one, in every case, without producing the result, unless with the carbon, which, when as pure as attainable, produced the very same result as the original powdered char. The char, minus the carbon only, had no effect. It was, therefore, clear that it was the carbon which had brought about the instantaneous decomposition. This carbon exists in a very fine state of division. Its action, in this case, must be analogous to that of platinum, in mysteriously determining the decomposition of certain substances, as the carbon itself is in no way acted upon. Further experiments were made, to determine whether this action was similarly promoted by other forms of carbon. Many varieties, from both vegetable and mineral sources, were tried; but in no case was the decomposition of the chromate solution promoted to any appreciable extent by their presence. Charred blood was also tried, and with more success, though the decomposition was by no means so rapid as in the case of the bone-char.

III. Prejudicial Action of Sulphites and Sulphates in the Refining Process.

Besides the impurities natural to unrefined cane sugars, and which vary in quantity, and to some extent in quality also, according to the care bestowed in the manufacture and other local circumstances, there are not unfrequently present one or more injurious agents which have been introduced, not as adulterants, but to counteract some adverse natural circumstance or action. Among these agents bisulphite of calcium occupies a prominent position. In several cane-growing countries, the natives, or colonists, are dependent, in great measure, upon wind power for the performance of certain mechanical operations; pressing the juice from the cane is one of these. The canes being ripe and the wind fair, the planter proceeds to cut down his crop; but, before this is well accomplished, the wind falls; what is to be done? To allow the cut canes to lie in their natural condition until a favourable breeze springs up, may be to submit to a very serious loss of crystallisable sugar by fermentation. To counteract this destructive process, bisulphite of calcium, mixed with water to the consistency of ordinary milk of lime, is sprinkled over the canes from time to

* *Gmelin*, Cav. Stoc. Trans., vol. iv., p. 120.

time, until the elements supply the necessary motive power to allow the pressing to proceed. As the pressing goes on, the lime salt mingles with the juice, and is never afterwards entirely removed from the manufactured sugar. Much of the raw sugar which arrives in this country, to undergo the process of refining, thus contains notable quantities of sulphites and sulphates; these range in quantity from the merest trace to amounts which might seem to some incredible. In these circumstances it becomes important to ascertain the action of these salts in the refining process, and their consequent effect upon the value of sugars containing them. In the first place, they, of course, in common with all other impurities, reduce the percentage quantity of saccharine matter in the sample; and as it often enough occurs that the *best looking* samples contain the impurities referred to in greatest quantity, it is always advisable to estimate the total impurities previous to purchase. The sugars being blown-up and mechanically filtered, are next submitted to the purifying and decolourising action of animal charcoal; in this process a large proportion of the sulphites and sulphates are removed and retained within the pores of the char. The washing, to which the char is afterwards subjected, removes a portion of these salts along with other impurities, but they are never entirely washed out. The re-burning succeeds the washing, and in this process the sulphates, or a portion of them, depending upon the temperature at which the re-burning is conducted and other minor circumstances, are decomposed at the expense of the carbon—carbonic anhydride being evolved and calcium sulphide formed. The char being re-burned and cooled is ready for its work of decolouration again; the sugar liquors—acid almost to a certainty—are run upon it, and as they pass through, decompose the calcium sulphide, with formation of hydric sulphide, which the liquors absorb. There are thus two prejudicial effects produced: first, the removal of a portion of the most valuable agent in the char—the carbon—and next the formation of an agent in the sugar solution, which is most potent in promoting fermentation, and consequent destruction of saccharine matter. The quantity of carbon removed and hydric sulphide produced by one complete circle of the refining process is comparatively trifling, but when it is remembered that the same char is often re-burned and used twice a week, the ultimate extent of the injury can be imagined. From extended personal observation, the author of these notes is satisfied that from 10 to 20 per cent of the decolourative power of animal charcoal may be destroyed in the course of twelve months by a continued use of sugars containing the agents referred to.

A little consideration will show, what numerous experiments have proved, that char *ready for re-burning* seldom or never contains sulphides, while re-burned char always contains more or less; *traces* of sulphur compounds being, as a rule, present in all unrefined sugars.

Long experience and numerous experiments have enabled the author to decide upon deductions to be made, from the marketable value of sugars, in proportion to the quantity of sulphates, &c., they contain. The mode of testing is exceedingly simple, but as the conclusions come to are quite arbitrary, so far as monetary figures are concerned, he would not advise the unexperienced to proceed upon his system, but would suggest to those interested in the problem a careful experimental investigation of the whole subject.

IV. The Chemical Impurities of "Low" Beet Sugars.

As a rule, the finest products of the beet are manufactured directly into loaves in the various beet growing countries; the second, or perhaps more frequently, the third crop of crystals being exported.

British refiners are thus called upon to deal with sugars containing large proportions of chemical impurities, some of them very injurious to the sugar itself, while others act most prejudicially on the charcoal used in the refining process. Amongst these agents, sulphates usually hold a prominent place; it is needless to say that their action is just as injurious in the product of the beet as in that of the cane. Alkaline chlorides also abound, and their action is at least as injurious as that of the sulphates. Any one who has had the opportunity of observing beet sugar liquor, and cane sugar liquor, of the same original colour, passed through separate cisterns of the same charcoal, must have been struck with the very great difference in the effect produced: the cane liquor bright and colourless, the beet *possibly* bright, but decidedly yellow; and this difference is rather increased than lessened by the after process of boiling. The share which the alkaline salts have in reducing the colour value of the refined product is unquestionable, and their injurious action does not end there; they tend throughout the whole refining process to destroy crystallisable sugar, while their action on the charcoal, unless when very copious washing is practised, is very objectionable. The salts refered to, being fusible, the risk of coating the char in the re-burning process is considerable. Several otherwise good chars, which have been sadly injured in this way, have come under the author's observation. The practical point to be observed is this, that whereas even the very lowest "beets" commend themselves to the eye, in virtue of the size, strength, and abundance of the grains or crystals, they are often so charged with potent impurities, as to be entirely inadmissible as subjects for the British refiner to operate upon. The evil effects of the repeated use of such low class beets, soon manifest themselves over the whole refining establishment—not least on the sale-room counter.

The foregoing has, of course, little or no reference to the beautiful first products of the beet, occasionally imported, though even these are tainted, to a greater or less extent, with some of the characteristics of the low beets.

In the circumstances here noted, it must be manifest to every refiner, that to purchase beet sugars, or indeed any sugar, as will be evident from a perusal of the preceding (III.) note, by the rule-of-thumb system, so generally prevalent, is, to say the least of it, very risky.

Nothing but rigorous chemical examination can point out the true commercial value of unrefined sugars. The eye can detect many useful indications of quality, but these ought always to be supplemented by an investigation of the qualities which do not appear on the surface, and which chemical analysis alone can reveal.

Dubrunfaut, who, along with other continental chemists, has made the action of the impurities of beet upon the crystallisable sugar a special study, has fixed upon a coefficient by which to arrive at the quantity of *extractable* sugar contained in any sample submitted to analysis. The removal of these objectionable salts has also engaged the attention of several eminent continental chemists, and from the results obtained, it is manifest that other methods of dealing with beet sugars must be adopted from that followed in the refining of the produce of the cane. We, in Britain, seem to have fallen asleep upon this subject. The process of sugar refining is eminently a chemical one, and at every stage there is room for investigation and improvement.

THE MODE OF TESTING MINERAL OILS USED FOR LAMPS.

By BENJAMIN H. PAUL., Ph.D.

The degree of inflammability of the mineral oil now used for lamps is a character which the chemist is sometimes called upon to determine; and since recent enquiries appear to indicate that there is considerable difference of opinion as to the mode in which mineral oil should be tested for the purpose of determining that character, I have thought that this subject, though not one of any scientific interest, would be worth bringing under the notice of the

readers of the CHEMICAL NEWS, especially since the degree of inflammability of mineral oil is now attracting considerable attention in reference to the question of danger attending the use of such oil in lamps.

All kinds of mineral oil, whether derived from coal, or bituminous shale, or from petroleum, are, by their nature, more inflammable than the fat oils, such as sperm oil and colza oil, formerly used for lamps, that is to say, they take fire more readily and at a lower temperature than the latter; they also differ from those oils in being partially volatile at a temperature which has no similar effect upon the fat oils. Since the vapour thus given off is inflammable, and, when mixed with air in due proportion, capable of exploding, it is evident that the use of any kind of hydrocarbon oil requires, for both the reasons just mentioned, a greater degree of care than is necessary in the use of fat oils.

In considering the question of danger to be apprehended from the use of mineral oil in lamps, the conditions under which it is used in a general way must be taken into account; and so far as the inflammability of the oil is concerned, the point to ascertain is not merely what oil may be used without any necessary danger, but what kind of oil will answer the purpose for which it is required as an illuminating material without, at the same time, requiring any greater degree of caution in its use than can fairly be expected under the circumstances. Even the more volatile portions of petroleum and paraffin oil, constituting what is generally termed "spirit," or naphtha, benzoline, ligroine, &c., may be burnt without any necessary danger in some of the ordinary paraffin lamps, which are constructed in such a manner that there is no free communication between the flame and the oil reservoir. But this material, which begins to boil below 100° F., and distils over completely below 300° F., while it is readily volatilised at the ordinary atmospheric temperature by contact with air, is much too volatile for general use in that way, except in the special form of lamp known as the "sponge lamp;" and, for that reason, it can scarcely be regarded as a suitable material for burning in what is termed the paraffin-oil lamp. The fact that it can be used in this way serves merely to show that any danger attending the use of mineral oil in lamps is less referable to its volatility and greater inflammability, as compared with fat oils, than it is to carelessness, or misuse, and the neglect of those precautions which the nature of this material renders indispensable. But, though the possibility of improper usage cannot reasonably be regarded as justifying any considerable restrictions in the application of a material so useful as mineral oil, still some allowance requires to be made for it; and since, in this respect, the degree of inflammability is the character of the greatest importance, it is customary, in the operation of refining, to separate and exclude from the oil to be used for ordinary lamps, a certain amount of the more volatile hydrocarbons contained in the crude petroleum or paraffin oil. The extent to which this is done is not in all cases the same, and there is some difference of opinion as to what should be the minimum degree of inflammability of the oil, or the minimum temperature at which it should be capable of giving of inflammable vapour, in order to ensure for it such a degree of safety as would be consistent with the general circumstances under which it is used in lamps and kept as a commodity in shops. By some, it is considered that when a flame is brought into actual contact with the oil, heated in an open capsule, it ought not to take fire, so as to continue burning, until the temperature reaches 130° F. Others, again, consider that, if it does not take fire at a temperature below 100° F., it is of a character fit to meet all requirements.

Hitherto, far less attention has been paid to the degree of inflammability of mineral oil than to the absence of smell and colour. It has also been customary in different countries to use oil differing widely in regard to the temperature, at which it would take fire. Some years ago, the oil generally consumed in this county had a very high firing point, and it was customary to test it by observing how long it would bear contact with the flame of a match without taking fire, or more accurately by observing the temperature at which it took fire and continued to burn. This temperature was generally from 120° to 130° F., and sometimes it was as high at 150° F. The oils manufactured about eight years ago, from Rangoon petroleum, and from coal or bituminous shale, were of this kind. On the Continent, oil inflammable at a much lower temperature has generally been preferred.

After the introduction of American petroleum, there was a marked difference in the character of the imported lamp oil manufactured from this material, so far as regards the degree of inflammability, and it would often take fire at a temperature little above 100° F. During the last three years, the firing point of this oil has been still further reduced, and probably the greater part of the lamp oil imported from America and made from petroleum, which has been consumed during that period has had a firing point below 100° F., sometimes considerably lower.

In addition to the differences, both of opinion and practice, in regard to the degree of inflammability of mineral lamp oil, there are also similar differences as to the mode of determining this character, and as to what is to be regarded as the firing point.

This oil being in all cases a mixture of several hydrocarbons belonging to the paraffin series chiefly, and varying in their boiling points from about 200° to upwards of 700° F., the temperature at which it begins to give off vapour will depend upon the boiling points of the more volatile hydrocarbons, and upon the amount of them contained in the oil. Consequently, when the oil is gradually heated in contact with air, and a flame is brought near the surface from time to time, there is always a little momentary flash, produced by the vapour taking fire; and this happens some time before the oil attains the temperature at which it takes fire itself, and continues to burn. The difference between the temperature at which the temporary flash takes place, and that at which the oil takes fire, will amount to from 10 to 20 degrees Fahrenheit.

Upon the assumption that an explosive mixture of oil vapour and air may be formed within the reservoir of a lamp, it has been urged that the temperature of the oil when this temporary flash takes place should be considered as the firing point of the oil.

The quantity of vapour given off by mineral oil at the temperature when the first temporary flash takes place, is generally very small, even when the oil itself takes fire at 100° F.; and as the oil in the glass reservoir of a paraffin lamp, while it is burning, seldom acquires a temperature more than about ten degrees above that of the surrounding atmosphere, there would not be much probability of any such quantity of vapour being produced within the reservoir as could give rise to explosion by contact with flame. In regard to this point, however, the construction of the lamp is of considerable importance. In some lamps the pin by which the height of the wick is adjusted is so arranged that there is free communication between the flame of the lamp and the oil reservoir, and between the two there is a small metal chamber, with a hole at the side, through which the pin passes. This chamber, in common with the other brass fitting of the lamp, being heated to a temperature much above 100° F., will of course become filled with vapour given off from the oil as it passes up through the wick; and that vapour, by mixing with air, may form an explosive mixture in the immediate neighbourhood of the flame. In other lamps the pin is fitted in such a way that there cannot be any accumulation of oil vapour near the flame, and there is not any communication between the flame and the reservoir, except through the tube in which the wick is placed. The latter form of lamp is in this respect much preferable to the other, and it is the only kind of lamp in which a very valatile oil can be burnt. But the fact of most importance in regard to the determination of the inflamability of mineral by the "flashing point" is that the result

obtained with a given sample of oil in this way, may vary several degrees, according to the mode in which the test is applied. If the surface of the oil is freely exposed to the air, in an open vessel, such as a shallow capsule, the firing point of the vapour may be found to be some degrees higher than when the test is applied in a small wide-mouthed bottle, or in the reservoir of a paraffin lamp, half-filled with the oil.

The difference before referred to between the temperature at which, in testing oil to ascertain the firing point, the temporary flash takes place, and that at which the oil itself takes fire and continues to burn, also depends very much upon the mode in which the experiment is made. With a shallow, open basin, the difference is much less than it is when a wide-mouthed bottle or a small lamp-reservoir is used. The more freely the surface of the oil is exposed to the atmosphere, the lower will be the temperature at which it takes fire; while, on the contrary, the less freely it is exposed, the lower will be the temperature at which the vapour given off takes fire. Consequently, in fixing a point of temperature as the minimum at which either the oil itself or the vapour it gives off, should take fire by contact with flame, it is necessary that the conditions under which the experiment is to be made should be precisely defined, and that the testing of oils should always be conducted in the same manner, so as to obtain uniform and corresponding results. It is, of course, desirable, also, that these conditions should assimilate as much as possible to those obtaining in a paraffin-oil lamp when it is burning, since any danger that might arise from the inflammability of the oil would exist chiefly in the ordinary use of this material in lamps.

It is singular, however, that the Act passed in 1868, to amend the Petroleum Act of 1862, prescribes a mode of testing mineral oil under conditions that are the direct opposite of those prevailing in the use of the oil. While a mineral oil lamp is in use, the oil is heated in a closed vessel partly filled with air, which thus becomes charged with oil vapour, proportionately to the volatility of the oil, or part of it, and to the temperature the oil is raised to. Any oil vapour given off is confined; and, if the oil be sufficiently volatile or sufficiently heated, such formation of oil vapour may result in the production of an explosive mixture within the oil-reservoir of a lamp.

On the contrary, in testing mineral oil according to the directions given in the Schedule appended to the Act of 1868, the oil is heated in an open vessel, with the surface freely exposed to the atmosphere. Under these conditions, any oil vapour formed is liable to diffuse away into the surrounding air, and become thus so much diluted as to lose its inflammable character. Consequently, the temperature at which the momentary flash takes place with any given sample of oil when a flame is brought near its surface, will be, for that reason, higher than when the escape and dilution of the oil vapour is prevented—as in a paraffin lamp, or by making the test in a partially-closed vessel.

A still more serious interference with the results of the test would be experienced if the operation were conducted in a place exposed to draughts; and probably much of the discrepancy in the results of oil-tests has arisen in this way.

But there is yet another source of discrepancy in the results of tests made in accordance with the directions of the Petroleum Act, and one which is of far more importance, because no notice is taken of it in those directions, and, consequently, its influence may be greater or less according to accident or to the practice of the operator. This source of error lies in the rate at which the oil is heated, or the time occupied in making a test. All that the Act directs in this respect is that "a small flame shall be applied to the bottom of the outer vessel," which serves as a water-bath, and that this vessel "shall be filled with cold, or nearly cold, water." Both these directions are extremely vague. But, leaving out of consideration any difference that might arise from using "cold" water at 40° F., or "nearly cold water" at 70° F., the rate of heating the oil from either temperature up to 100° F. has such an influence on the result obtained that there may be a difference of quite 5° in the flashing point of a given sample of oil, accordingly as the heating is made to occupy a longer or shorter time; and this will be the result, even though a "small flame" be used in both cases. Some experiments I have recently made show that there is a possibility of even greater variation in the result obtained as the "flashing point" of one and the same sample of oil.

Such a defect as this in the prescribed mode of testing mineral oil leaves the practice of this test entirely subject to the option or fancy of the operator; and it is alone sufficient to render the application of the test totally useless for the purpose of determining the character of mineral oil in regard to inflammability, and worse than useless for all the purposes of the Petroleum Act, besides rendering this Act and its application a possible source of serious inconvenience to those engaged in the mineral oil. On these grounds alone, therefore, there seems to be ample need for a revision of the law, and for the adoption of a more suitable test.

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ON CHEMICAL EQUILIBRIUM.

Influence of Pressure on the Reaction between Carbon and Hydrogen.

By M. BERTHELOT.

The play of conflicting chemical reactions, and the equilibrium established between them, are simplest, theoretically, when such reactions are developed in homogeneous systems, entirely gaseous, or even entirely liquid, and capable of remaining homogeneous during the whole duration of the experiment.

Under these conditions, all the reacting particles remain in complete and unceasing contact, no secondary complication occurring to withdraw one of them from the field of chemical action. Not so in the case of reactions which take place between a gas, or liquid, and a solid; under these circumstances, reaction occurs only at the points of contact, which undergo the influence of numerous physical conditions, accessory and foreign to true chemical action, which they tend to complicate.

Meanwhile, the principal masses, separated from each other by the gaseous state of the one, opposed to the solubility of the other, remain neutral and inactive.

The homogeneous system is, therefore, in my opinion, the best adapted for the theoretical study of affinities—that is, the study of those forces which determine chemical combinations and decompositions.

From this point, my researches commenced upon the study of affinities, examined in ethereal reactions, which present a type of slow progressive action and of action limited by inverse reaction.

Ethereal reactions may be examined by an entirely gaseous system, or by one wholly liquid and permanently homogeneous. Their characteristic equilibrium varies continually with the relative proportions of reacting bodies, contrary to what occurs in reactions of acids on bases. It also varies continually in gaseous systems, according to the pressure—that is, according to the condensation of matter, but it is independent of temperature between the limits of zero and 280°.

The fundamental condition of homogeneity is, perhaps, fulfilled by reactions effected on the gaseous system under lively combustion, such as were studied with such advantage by M. Bunsen. Here the reactions are abrupt, and occur almost instantaneously: the equilibrium which generally arises between contrary actions no longer obeys the laws of continuity, but varies after the manner of

chemical equivalents. When the proportions of reacting bodies change progressively—as, for instance, in systems formed of hydrogen, oxide of carbon, and oxygen, on the contrary, the relative proportions of products formed vary by abrupt leaps.

The relation between the entire volume of a mixture of combustible gas and that of the portion which will produce, at a given temperature, a new composition, also varies by abrupt jumps, when the temperature is gradually made to vary by introducing into the mixture an inert gas. There will then exist several intervals of temperature, more or less great, between which the limit of the reaction is independent of changes of temperature. To establish a complete parallel between ethereal reactions. and those of the gaseous systems, the influence of pressure upon the latter must be ascertained.

Between acetylene, hydrogen, and carbon reduced to vapour by the electric arc, or spark, such an equilibrium is established that a mixture of acetylene and hydrogen, made in suitable proportions, remains unaltered by the spark. If, on the contrary, acetylene predominates, it decomposes until the above-mentioned proportions are reproduced. These facts were established in a previous communication; since then, I have submitted a mixture of acetylene and hydrogen to the action of the spark under different pressures. This is my method of operation:—

The gases were contained in large eprouvettes, into which were passed gas tubes, bent round and traversed by thick platinum wire. The spark produced by a strong induction coil passed direct between the platinum wires, without breaking upon the glass or any other cold body capable of suddenly condensing the carbon vapour. The pressure was measured directly by the height of a column of mercury, and the mixture was analysed every hour, until the composition remained invariable during three consecutive tests. In the experiments made under very feeble pressure, it was necessary to repeatedly cleanse the eprouvettes containing the gaseous mixture, and, even then, to reject the first trials, because the formation of a small quantity of oxide of carbon proved the introduction of small quantities of air, or of moisture contained with the mercury. This oxide of carbon disappeared after the second or third trial, on care being taken to preserve from contact with the air the interior of the eprouvette and the tubes which conducted into it the platinum wire. The following results were obtained:—

Pressure. m.	Limit of Proportion of Acetylene in 100 volumes.
3·46	11·9
0·76	12·0 to 12·5 (in several trials.)
0·42	11·9
0·41	12·0
0·31	6·5
0·23	3·5
0·18	3·1
0·10	3·1

The pressure was not reduced further, because the volume of gas under treatment would have been too small for correct analysis.

These numbers prove that the equilibrium between the carbon, hydrogen, and acetylene remained fixed at the same limit (12·0) for pressures which varied from 0·41 m. to 3·46 m., that is to say, as 1 is to 8½.

The increase of pressure has no effect but to augment extremely the resistance to the passage of the spark, and also its brilliancy. According to my experience, this increase of brilliancy does not correspond with any change in the composition of the gas traversed by the spark.

Even the rapidity of decomposition, which causes the disappearance of the excess of acetylene under treatment, does not appear to vary much with pressure, as far as it was possible to judge under the circumstances. Below 0·41 m.—that is, at 0·31 m.—the limit is suddenly brought down to 6·5—viz., half the preceding one. At 0·23 m., the limit is suddenly reduced to the qnarter of it, and remains the same, at least to 0·10 m.

Thus, while the pressure varies continually, the equilibrium between the acetylene, carbon, and hydrogen changes, by sudden leaps, in ratios which are multiples of each other.—*Comptes Rendus*, vol. lxviii., p. 810.

ON THE

MICROSCOPICAL EXAMINATION OF MILK UNDER CERTAIN CONDITIONS.*

By J. B. DANCER, F.R.A.S.

IN August and September last an account appeared in one of the newspapers (and also in other periodicals), which had been copied from the *Journal des Connaissances Médicales*, of some microscopical observations made by M. V. Essling on Milk, in which the author stated that "if the surface of fresh cream be examined under the lens, one perceives, amid myriads of milky and fatty globules, a number of either round or oblong corpuscles, sometimes accompanied with finely dotted matter, being neither more nor less than germinative masses of vibrios—just what is seen in most substances in a state of putrefaction. In summer these corpuscles make their appearance within 15 or 24 hours after milking; in winter they will be perceptible after the lapse of two or three days. If the observation be continued until the moment of coagulation, we see these corpuscles increase in number, bud, form ramified chains, and at length be transformed into regular mushrooms or filaments composed of cells placed end to end in simple series, and supporting at their extremities a spherical knob filled with granulous matter. M. V. Essling thinks that they may be classified among the Ascophora. But the important point is, that the first appearance of these spores occurs *before the milk gets sour*, and as this substance is almost the exclusive aliment of children, there is reason to suppose that many of the gastric affections to which they are subject are owing to this state of the milk. To prevent these evil consequences, M. V. Essling recommends the milk to be drunk as soon as possible after extraction, and, at all events, to keep it closely bottled during the interval, so as to keep out the smallest particle of air. Moreover, the temperature should be kept as nearly as possible the same as that which the milk had in the teats."

Having for many years been familiar with the microscopical appearance presented by milk and cream, and not having seen the changes as described by M. V. Essling, I was desirous of satisfying myself on this point, more especially as it affected a very important article of food. The composition of ordinary milk, as stated by Fownes, is as follows:—

Water	873·00
Butter	30·00
Casein	48·20
Milk sugar	43·90
Phosphate of lime	2·31
Phosphate of magnesia	0·42
Phosphate of iron	0·07
Chloride of potassium	1·44
Chloride of sodium	0·24
Soda in combination with casein	0·42
	1000·00

* Read before the Manchester Literary and Philosophical Society, November 30th, 1869.

Composition of casein in 100 parts:—

Carbon	53·83
Hydrogen	7·15
Nitrogen	15·64
Oxygen } Sulphur }	23·37
	100·00

Composition of albumen in 100 parts:—

Carbon	53·5
Hydrogen	7·0
Nitrogen	15·5
Oxygen	22·0
Phosphorus	0·4
Sulphur	1·6
	100·00

Casein and animal albumen are remarkably similar in composition; casein differs in not being coagulated by heat, and is precipitated by acetic acid. Certain animal substances cause its coagulation, such as the dried stomach of the calf, known as rennet, used in the manufacture of cheese.

When a thin film of milk is examined with the microscope, it is found to be a transparent fluid, in which are floating numerous transparent globules of fat; these are surrounded by a thin pellicle, and when this pellicle is broken mechanically, as by churning, the fat is liberated and forms butter. The fluid part consists of casein, saccharine matter, and salts in solution. The proportion of these organic principles varies in different animals, and also in the same animal when fed under different conditions. Human milk usually contains a larger proportion of sugar than cow milk, and is coagulated with greater difficulty. It is well known that the secretion and quality of milk is influenced by the mental emotions. Milk as obtained in towns is frequently adulterated, and as foreign matter would alter its microscopical characteristics, it was necessary to procure pure milk. One of our members, Mr. Kipping, kindly supplied me with a bottle of fresh-drawn milk. The cow had calved about three months previously, and had been fed on grass, bran, and bean-flour. This milk was examined soon after I received it, and was found to be very rich in oleaginous globules, forming a plentiful supply of cream. There was no appearance of dotted matter or any fungoid growth when examined by powers varying from 200 to 1500. The smallest oil globules exhibited (as usual) great molecular activity. A bottle was filled with some of this milk and securely corked; other portions of the milk were placed in open cups; one cup was kept in a cabinet which was closed during the day, the milk of the second cup was placed in a closet, the atmosphere of which I knew to be favourable to the growth of fungi, the Mucor Mucedo being the most abundant and of the same family as that mentioned as having been found in cream by M. V. Essling. The milk in the bottle and that in the cups was examined daily, precautions being taken to close the bottle speedily after a portion was removed. On the third day, the milk in the open cups was sour to the smell, but no change appeared visible under the microscope; the upper portion of the milk in the bottle had become very rich in oil globules by the formation of cream. On the fourth day, the casein had coagulated in the milk in the open cups, and the flaky precipitate was visible under the microscope; the pellicle surrounding the oil globules now appeared to be very easily ruptured, and with the slightest pressure some of the globules could be joined together—sometimes a number of globules which had been ranged in line by a current would coalesce by a slight movement of the fluid, and form an elongated mass. Fifth day, no appreciable alteration. Sixth day, the milk which had been placed in the closet had patches of mould visible on its surface; a microscopical examination of this mould showed it to be the Mucor Mucedo, such as I had frequently found on fruit which had been left in this closet. The fungi appeared on the surface only, no trace of it could be found in the milk taken from various depths. The milk in the cup kept in the cabinet exhibited no appearance of the Mucor Mucedo or any other vegetable or animal organism; it had become thickened into a pasty mass, with an intensely sour odour. These observations were continued for eleven days, and the only difference observable was in the oil globules—they began to lose their spherical form, as if the investing pellicle had been weakened in parts and had become expanded.

These experiments were repeated with a second supply of milk, which Mr. Kipping kindly supplied, and the results were alike in both cases. The range of temperature during the experiments was from 45° to 63° F. These experiments would lead me to believe that vegetable organisms do not, as a rule, make their appearance in pure unadulterated milk, unless it is exposed for some time to atmospheric influences; most probably the spores are supplied by the atmosphere. Further experiments are wanting to decide the question. The microscopical examinations should be continued in hot weather. I hope to be able to resume the enquiry next summer under different conditions, which have suggested themselves during the examinations I have detailed. In any case, M. V. Essling's suggestion to bottle the milk is very good, and, in my opinion, cream pans with covers would be a very great improvement on the open ones as at present employed, at the same time having due regard to the cleanliness of the apartment and vessels in which the milk is kept.

In a microscopical examination such as I have recorded it is quite necessary to have pure materials. The milk as supplied by vendors we know to be very frequently adulterated, and the most simple and easy method is by the addition of water. We know also that in towns where the water has a high character for purity, it sometimes happens in dry hot weather the reservoirs are charged with vegetable and animal organisms. Milk may not always have town's water added to it; in this case there may be an extra quantity of vitalised matter introduced. What a surprising account a microscopist might furnish from the examination of milk containing such an importation! In the cold weather, such as we have at present, animal organisms are not so abundant, and this may account for their absence from a sample of milk obtained in this town, in which I found *Algæ*, but not belonging to the pure milk. One curious circumstance was noticed in this milk, no Mucor Mucedo appeared in or on it, although exposed in the closet for the same length of time as Mr. Kipping's milk, which showed signs of this growth on the sixth day, and on the twelfth day the town milk had none visible. I may mention that pure milk in a bottle securely corked remained fresh twelve days; possibly the low temperature favoured its preservation.

ON THE

ACTION OF CYANOGEN ON ANTHRANILIC ACID.*

By P. GRIESS, F.R.S.

Some time ago,† I pointed out the action which takes place when cyanogen gas is passed into an acoholic solution of amidobenzoic acid. The principal product of this reaction is, as I have shown, a yellow compound of cyanogen and amidobenzoic acid, of the formula—

$$C_7H_5(NH_2)O_2,2CN,$$

which separates in large quantities as soon as the alcoholic solution of amidobenzoic acid is nearly saturated with cyanogen. When anthranilic acid (a body isomeric with amidobenzoic acid) is submitted, under the same condition, to the same reagent, a totally different reaction

* A paper communicated to the Royal Society.

† *Zeitschrift für Chemie*, new series, vol., iii., p. 533, and vol. iv., p. 389.

takes place. In this case, the solution remains either perfectly clear, or only traces of a similar yellow compound are precipitated. By allowing the alcoholic solution of anthranilic acid saturated with cyanogen to stand for several days, the acid is almost entirely converted into a new compound of the empirical formula $C_{10}H_{10}N_2O_2$; two other new compounds (an acid and an indifferent body) are at the same time formed. It is worthy of remark that none of these compounds are isomeric with any of the bodies which, by the same process, are formed from amidobenzoic acid. Each of them belongs to a different type.

I propose, on this occasion, to treat only of the principal product of the reaction—viz., the compound $C_{10}H_{10}N_2O_2$. It is prepared in the following manner:—An alcoholic solution of anthranilic acid is saturated with cyanogen gas, and left to stand for about eight days. The alcohol is then evaporated at a low temperature, and the crystalline residue washed several times with dilute solution of carbonate of ammonia, by which any traces of the new acid (one of the by-products of the reaction) are removed. It is then further purified, by re-crystallisation from alcohol, with the addition of a little animal charcoal. The indifferent body already referred to, which is very little soluble in alcohol, is thus separated. The new compound, $C_{10}H_{10}N_2O_2$, is then obtained in the form of white acicular crystals, which are very little soluble in boiling water, but dissolve readily in boiling alcohol and ether. It fuses at 173° C., and can be distilled in small quantities, without undergoing decomposition. Its formation may be expressed as follows:—

$$\underbrace{C_7H_7NO_2}_{\text{Anthranilic acid.}} + \underbrace{2CN}_{\text{Cyanogen.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}} = \underbrace{C_{10}H_{10}N_2O_2}_{\text{New compound.}} + \underbrace{CHN}_{\text{Hydrocyanic acid.}} + \underbrace{H_2O}_{\text{Water.}}$$

According to this equation, alcohol, as well as anthranilic acid and cyanogen, take place in the reaction. Confirmatory experiments which I have made show that the compound in question is really an ether.

Action of Hydrochloric Acid upon the Compound $C_{10}H_{10}N_2O_2$.—Ordinary hydrochloric acid dissolves this body, and, when cold, does not act upon it. On boiling, however, speedy decomposition sets in, and a new body separates, the formation of which is represented by the following equation:—

$$C_{10}H_{10}N_2O_2 + H_2O = \underbrace{C_8H_6N_2O_2}_{\text{New compound.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}$$

This new compound, $C_8H_6N_2O_2$, is very difficultly soluble in boiling water, alcohol, and ether, and crystallises in small white brilliant plates. It is likewise dissolved by solutions of caustic alkalies, but is again, however, separated by carbonic acid. On adding a solution of silver salt to its aqueous or alcoholic solution (neither of which has any action on vegetable colours), a white precipitate is formed. Fuming nitric acid converts this body into a nitro-compound, crystallising in honey-yellow prisms, of the composition $C_8H_5(NO_2)N_2O_2$. On treating the latter with sulphide of ammonium, or with tin and hydrochloric acid, it is reduced, and furnishes a basic amido-compound, crystallising in slightly yellowish-tinted needles, difficultly soluble in all neutral liquids. Its composition is $C_8H_5(NH_2)N_2O_2$. Compounds of this amido-body, with acids, crystallise well generally, but are, for the most part, difficultly soluble.

Action of Ammonia on the Compound $C_{10}H_{10}N_2O_2$.—On digesting the body for several days, at 100° C., in sealed tubes, with alcoholic ammonia, it is gradually converted into a base, almost insoluble in water, and difficultly soluble in boiling alcohol. From this, it crystallises in brilliant nacreous plates.

Its composition agrees with the formula $C_8H_7N_3O$, and its formation takes place according to the equation—

$$C_{10}H_{10}N_2O_2 + NH_3 = \underbrace{C_8H_7N_3O}_{\text{New base.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}$$

This new base is monacid. Its nitrate is especially characteristic, for it is almost insoluble in water and alcohol. It separates out from very dilute solutions of the base, in the form of small white plates, on the addition of nitric acid. Its platinum-salt crystallises in thick yellow needles, and has the composition—

$$2(C_8H_7N_3O),2HCl,PtCl_4.$$

The compounds just described may, one and all, be viewed as substitution products of anthranilic acid, viz.:—

Anthranilic acid	$C_7H_7NO_2$	$=C_7H_6NO.HO.$
New ether	$C_{10}H_{10}N_2O_2$	$=C_7H_5(CN)NO.C_2H_5O.$
Product of decomposition of the former with HCl	$C_8H_6N_2O_2$	$=C_7H_5(CN)NO.HO$
Nitro-compound	$C_8H_5(NO_2)N_2O_2$	$=C_7H_4(NO_2)(CN)NO.HO.$
Amido-compound ..	$C_8H_5(NH_2)N_2O_2$	$=C_7H_4(NH_2)(CN)NO.HO.$
Base obtained from the ether by the action of NH_3 ..	$C_8H_7N_3O$	$=C_7H_5(CN)NO.H_2N.$

As I intend taking an early opportunity of considering the rational constitution of these bodies somewhat more fully, I content myself, for the present, with remarking that I am inclined to regard the base $C_8H_7N_3O$ as the creatinine of the benzoic series; it stands to anthranilic acid exactly in the same relation as creatinine *par excellence* does to sarcosine—

$\underbrace{C_8H_7N_3O.}_{\text{Benzo-creatinine.}}$	$\underbrace{C_4H_7N_3O.}_{\text{Creatinine.}}$
$\underbrace{C_7H_7NO_2.}_{\text{Anthranilic acid.}}$	$\underbrace{C_3H_7NO_2.}_{\text{Sarcosine.}}$

Herr Neubauer has shown* that creatinine, when treated in a sealed tube with baryta-water, undergoes the following change:—

$$\underbrace{C_4H_7N_3O}_{\text{Creatinine.}} + H_2O = \underbrace{C_4H_6N_2O_2}_{\text{Methylhydantoine.}} + NH_3.$$

I consider it highly probable that the base $C_8H_7N_3O$ will split up in like manner, with the formation of the above-described compound, $C_8H_6N_2O_2$, according to the equation—

$$C_8H_7N_3O + H_2O = C_8H_6N_2O_2 + NH_3.$$

Indeed, this latter compound exhibits great resemblance in its chemical deportment to the methylhydantoine of Herrn Neubauer.

In conclusion, I should point out that the azodioxindol described by Herrn Baeyer and Knop, in their paper "On Indigo Blue," is isomeric with the before-mentioned compound, $C_8H_6N_2O_2$. These two bodies show, moreover, great similarity in other respects, so much so that I should feel inclined to view them as identical, if their fusing points did not differ essentially. Herrn Baeyer and Knop state that the fusing point of their azodioxindol is 300° C.; while the compound I obtained fuses above 350° C. Should it turn out, however, on further investigation, that the two bodies are identical, the compound $C_8H_6N_2O_2$ would have to be regarded as the first derivative of indigo which has ever been prepared synthetically, and which, like indigo blue itself, contains 8 atoms of carbon.

ON THE

SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER.†

By J. ALFRED WANKLYN.

IN a remarkable paper which appeared in the *Philosophical Transactions* (vol. clvi., p. 37, 1866), Frankland and Duppa described the products obtained on treatment with iodide of ethyl of the yellow wax-like mass given by the action of sodium on acetic ether. Besides the description

* *Ann. der Chem. und Pharm.*, vol. cxl., p. 26.
† A paper communicated to the Royal Society.

of the compounds, Frankland and Duppa give a theory of their origin, which theory is embodied in four equations, expressive of Frankland and Duppa's view of the origin of the wax-like mass. As I have already pointed out, each one of these four equations affirms the evolution of an equivalent of hydrogen by every equivalent of sodium employed.

It is an established fact that neither acetic ether, nor any other ether, ever evolves hydrogen by reaction with the alkali metals. All equations which assume evolution of hydrogen in these reactions are, therefore, inadmissible.

At the end of my paper in the January number of Liebig's *Annalen*, I promised to give an explanation of Frankland and Duppa's products, which should not involve the assumption of evolution of hydrogen. That explanation I now give.

On reference to Frankland and Duppa's paper just cited, it will be found that the products described by them as obtained from the "wax-like mass" and iodide of ethyl are the following:—

(A). $C_8H_{14}O_3$, liquid boiling at 195° C.
(B). $C_{10}H_{18}O_3$, liquid boiling at 210° C. to 212° C.

butyric ether, caproic ether, and also some unacted-upon acetic ether, and a considerable quantity of common ethylic ether.

The history of these compounds is, therefore, the task set before me.

I have already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium-triacetyl. Nothing else seems to be produced directly; but the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylene-sodium in the manner described by me on a former occasion. (Of course, the extent to which this secondary action takes place will be determined by the exact circumstances of the experiment). We have, therefore, in the wax-like mass, got, by prolonging the action of sodium on acetic ether—

Ethylate of sodium	C_2H_5NaO.
Sodium-triacetyl	$C_6H_9O_3Na$.
Acetate of ethylene-sodium	$C_4H_7NaO_2$.
Alcohol	C_2H_6O.

On the first three, iodide of ethyl acts, giving iodide of sodium and organic liquids.

From the ethylate of sodium comes the common ether.

From the sodium-triacetyl comes ethyl-triacetyl, which is $A = C_8H_{14}O_3$, having been got by Geuther from the pure sodium-triacetyl.

From isolated acetate of ethylene-sodium and iodide of ethylene, I have recently obtained liquid B ($C_{10}H_{18}O_3$) thus:—

Acetate of ethylene-sodium. Alcohol.

$$2C_4H_7NaO_2 + 2C_2H_5I = 2NaI + C_2H_6O + C_{10}H_{18}O_3.$$

The liquid prepared by me boiled at 212° C., and gave carbonate of baryta with baryta-water, and was identical with Frankland and Duppa's liquid B.

By the action of liquid A upon ethylate of sodium, Geuther has recently shown that butyric ether is produced. Geuther's reaction I write thus:—

Acetate of ethylene-sodium. Butyric ether.

$$\text{(A). } C_8H_{14}O_3 + C_2H_5NaO = NaC_2H_4,C_2H_3O_2 + C_6H_{12}O_2.$$

Finally, I predict that liquid B will give—

Caproic ether.

$$\text{(B). } C_{10}H_{18}O_3 + C_2H_5NaO = NaC_2H_4C_2H_3O_2 + C_8H_{16}O_2.$$

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from vol. xx., p. 320.)

From the explanation already given of the various modes in which light may be polarised, it is evident that one-half of the illuminating power is thrown away by the use of the polarising prism; this loss becomes a very serious matter when high magnifying powers are used, and as much valuable work is to be done by employing polarised light in combination with objectives of ¼ inch and shorter focus, it becomes necessary to find some means of increasing the intensity of the illuminating pencil under such circumstances. Polarised light can be concentrated by lenses in the same manner as common light, and, after condensation, still retains its peculiar properties. In large microscopes, provision is made for fitting the Nicol prism below the achromatic condenser, and a set of Darker's selenites between them; this, with a good tourmaline or Herepathite for an analyser, will enable observations to be carried on with very high powers, and with nearly the same ease as by ordinary illumination. With small microscopes, Collins's Webster condenser, which is constructed to carry a Nicol prism, will be found a very efficient illuminator, as its lenses are large, and it supplies an excess of light when used without diaphragms, it will be found very suitable for polarising purposes. Its capability of being adapted to any instrument is another recommendation. The author can speak favourably of its performance with his own microscope, in which the unusually short distance between the stage and mirror prevents the use of any other condenser. The selenites can be placed between the Nicol prism and the condenser, as usual in microscopes with substage fittings, but with small instruments the stage arrangement must be used; the focus of the Webster is sufficiently long to work through the three selenites without material injury to the illumination, when Mr. Bailey's or other thin mounting is employed.

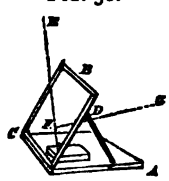
In carrying on observations by the aid of polarised light, it is necessary that the substance to be examined should be rendered as transparent as possible, by immersion in a suitable medium. Those which render objects so transparent that the details are almost invisible under ordinary illumination, are in general very suitable for polariscope purposes.

The facts which polarised light reveals are principally differences of density in tissues, the existence of which we should not be aware of without such aid. With regard to crystals, the polariscope at once distinguishes those which belong to the cubic system, such as common salt, which has no doubly refractive power, and, in common language, does not polarise from those of the other systems, which, owing to their double refraction, are among the most brilliant of polariscope objects. Not only differences of density are made evident by the use of polarised light, but also minute variations of thickness when the substance examined is possessed of doubly refractive properties, which are at once shown by a difference of colour, which defines the boundaries of the thickened portion, although this from the hyaline nature of the substance might be perfectly invisible

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

when illuminated in the ordinary manner. This is very often the case with the secondary deposits in vegetable tissues, which are to be seen most clearly when viewed with polarised light and sufficiently high powers. Sections of such substances as horn and tissues resembling it, as whalebone, &c., which exhibit little or no structure with common light, at once display differences of density indicated by colour when examined with the polarising microscope. A very interesting microscopic object is made by Mr. Bailey, consisting of a bar of glass, which is capable of being pressed by a screw. This, when examined by polarised light, exhibits no doubly refractive appearances so long as the screw does not touch it; but when pressure is applied, dark or coloured bands make their appearance around the point of the screw, extending to a greater or less distance, according to the amount of pressure employed, showing at once that some change has taken place in the molecular arrangement of the glass. Nearly similar bands are to be seen along the sides of a recent diamond cut and around the dot made by a slight blow of a steel centre punch, in both cases showing that the glass has been subjected to some strain. Opticians, in fitting lenses into cells, are careful to avoid pinching the glass, lest double refraction should be produced. Coloured bands are easily seen in pieces of thick plate-glass which have been rapidly cooled. These are best shown in Lecount's polariscope (Fig. 38), in which the polarised

Fig. 38.



ray, G, is made to pass twice through the piece of unannealed glass, F, which very much increases the intensity of the coloured bands. In this simple instrument the bundle of glass plates, B, acts as a polariser by reflection, and at the same time as an analyser by refraction, the light being reflected from the bundle through the object, and returned through it by the mirror, C, the bundle analysing the polarised ray, F, on its passage through it to the eye at E. The colours produced by varying thicknesses of selenite may be seen with the microscope in a small piece, roughly split, and mounted in balsam. It will be found that there will be a change of colour at every difference of thickness.

The object should be viewed, in the first instance, with the selenite plate, and the appearances noted which present themselves when both analyser and polariser are rotated. If the construction of the microscope permit, the object itself should also be rotated. Should no effect be produced by the prisms alone, a selenite may be used, commencing with one of little retarding power as ¼ of Darker's series. This should be rotated, and also the prisms before going through the various degrees of retardation.

Substances having a very feeble doubly refractive power are much assisted by using a selenite of suitable thickness, and details are often better seen with selenites of one colour than another. Darker's series offers great facilities for readily obtaining the most suitable tint. When a less power than that given by the ¼ is required, it can be obtained by turning the plate more or less towards one of the optic axes, which are situated at 45° from the P. A. mark, and the other depolarising axes. Also by using plates of mica, thin enough to just let a little light into the darkened field. Care should be taken to use sufficient light, and employ the condenser whenever necessary. As a general rule, with high powers, the light cannot be too strong; sometimes direct sunlight may be used with advantage. The effect of increase of illuminating power with the polariscope is not that of dilution, like excess of light pouring through a transparent coloured object, but as the coloured wave is augmented, intensity of colour and stronger definition is the result.

The polarising microscope is a great aid to the knowledge of structure, and an examination cannot in any way be considered as complete in which this most searching mode of investigation has been neglected. Hitherto, the polariscope has been considered rather in the light of a toy than as a valuable instrument of research, and it has therefore become necessary to devote so much of this elementary course of instruction to the application of polarised light to microscopical purposes.

(To be continued.)

NOTICES OF BOOKS.

Elementary Chemistry. By the Rev. William Grist, Grammar School, Bewdley. Part I.—*The Elements.* Birmingham: Cornish Brothers. 16 pages; 8vo.

The author of this work, imagining, we suppose, that there was a great dearth of elementary works on chemistry, determined to bring his own grist to the mill. We are greatly surprised that he could find a miller to grind it, and we pity those who may attempt to eat the bread which has resulted; for, without the least doubt, it will disagree with the first person who partakes heartily of it.

We have an account of the elements (which, the author informs us, "are more than sixty in number, more than fifty of which are metals") compassed in a span of sixteen small octavo pages. We can easily imagine how lengthy and lucid the descriptions of each element must be. For example, strontium receives the following amount of notice:—"This greatly resembles barium, but its salts are not poisonous. One of its salts is used in red-fire." While molybdenum has nearly a line devoted to it—"Molybdenum is white, brittle, and very infusible." What an example to prolix writers! What can be more terse than the above?

Now, as an example of the author's English, we may as well quote the first paragraph in the book:—"Chemistry is the science that has for its object the discovery, nature, properties, and combinations of the elementary substances, and also the laws which govern the production of their combinations." Again, in speaking of the non-metallic elements, he remarks, with singular perspicuity, "These may be divided into three groups—invisible gases, chlorine group, and (excepting iodine) solids." As to the author's Latin, he gives *Hydrargyrus* as the term for mercury. As to his general accuracy, he informs us that iodine is "obtained from the ashes of seaweed, after the soluble parts have been extracted;" that sulphur "melts at a little above the boiling point;" that the specific gravity of potassium is 0·086, of sodium 0·097, and of lithium 0·059; that sodium "becomes red-hot when it touches cold water, and burns with a bright yellow flame if the water be hot;" that "fire appears to be the effect of violent combustion." We will cease here. We will not

ask how, when, and where the author studied chemistry. We will not ask what has induced him to rush with such inconsiderate haste into print. We will not ask the aim, object, design of the work before us. But we will ask him if he is aware of the spirit which is abroad among our schools in regard to science teaching; if he knows of the many accurate, concise books by eminent men, written specially for the requirements of our schools; if he recognises the injury which he is doing by making public false science, inexact method, the truths of nature perverted by a sojourn in the caves of his mind, and returned maimed into the light of day.

At a time when the desire for sound training in science is becoming general, a work of this nature does infinite harm, and brings the contempt of the public both upon the science and its teacher. We recommend Mr. Grist to give up writing on chemistry; to devote as much time as he can spare to the study of it for the next twelve months, and then, if need be, to teach it by the help of some good work specially adapted for schools—such as the work of Roscoe, of Bloxam, of Harcourt and Madan, of Barff, &c.

Chemistry for Schools, an introduction to the Practical Study of Chemistry. By C. Haughton Gill, Assistant Examiner in Chemistry at the University of London. 100 Illustrations. London: James Walton, 1869. 315 pages.

This work is intended to be used as a manual for schools where chemistry forms a part of the ordinary routine work; and one of its main objects is the cultivation of "scientific habits of thought." It does not appear to differ materially from any of the many class-books which have appeared during the last few years; it is most nearly related to Dr. Williamson's "Chemistry" (Clarendon press series), and his nomenclature is followed. The text is somewhat uneven, and in another edition should be carefully examined; in one portion it is turgid, in another, rugged and clumsily constructed; thus the "*genesis* of ammonia," and the "change of proportional composition" is described in one place, while in another, we find such expressions as "got rid of," "a *bit* of this, a *pinch* of that," "the wood is re-lit with a little pop," "To do this, it is necessary to act on it by other bodies, which must be admitted to be what they are described to be," and so on. All this, however, refers to the diction only; the subject matter appears to be sound and well arranged. There is evidence of much hard work, and the book is eminently comprehensive; otherwise it is admirably printed, and of very convenient form, and we should be sorry to regard it as labour lost. The work is divided into twenty-two chapters; to each of which is appended a list of questions. The appendix contains a very useful chapter on "crystalline systems," illustrated by woodcuts of the typical forms. There is also a chapter on the metric system, by Mr. Walker, one of the Mathematical Masters in University College School, in which we find ready rules for various conversions; thus—"To convert kilomètres into miles, multiply by 5 and divide by 8. To convert mètres into yards, multiply by 35 and divide by 32. To convert decimètres into feet, divide by 3. To convert centimètres into inches, multiply by 4, and reject the last figure. To convert millimetres into inches, or decimals of the inch, multiply by 4, and point off the last two figures. To convert miles, yards, feet, inches, into metric equivalents, multiply by the divisors, and divide by the multipliers, as given above."

The Examination of Petroleum and other Mineral Oils according to the Petroleum Act, 1868. By A. Norman Tate, Analytical Chemist, &c., &c. London: H. Greenwood. 1869.

The author of this small pamphlet has, we think, done good service to all who have in any way to do with petroleum or other mineral oils, by writing this very clear paper on a subject which, as is justly pointed out by its experienced author, is not so well defined as it ought to have been. The paper contains valuable and definite directions about the testing or ascertaining of what is termed the *flashing point*. We recommend the perusal of this pamphlet to all parties interested in this subject, and especially to those who by the Act are called to carry out the operative tests, viz., the inspectors of weights or measures, or other persons duly appointed to inspect weights and measures as testers of petroleum. We entirely approve of the author's remarks made on this score.

A Manual of Diet for the Invalid and Dyspeptic, with a Few Hints on Nursing. By Duncan Turner, Licentiate of the Royal College of Physicians, &c., &c. London: John Churchill and Sons. 1869.

The object the author has sought in publishing this small essay is to convey, in a few words, avoiding as far as possible technical terms, necessary information to a larger class than would be expected from the title of the book, which contains six chapters and an appendix of formulæ. We find that the volume contains, written in a popular language, a great deal of useful hygienic information, and we heartily recommend it to all households, where, especially in the hands, or better still in the head, of the mistress, this useful knowledge deserves a permanent place. The appendix is highly commendable for its sound directions as regards the preparation and cooking of food, which has more to do with digestion than is commonly supposed in this country.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Revue Hebdomadaire de Chimie, December 9, 1869.

Quantitative Estimation of Sulphur in Cast-Iron and Steel.—M. Eggertz.—The process invented by this author is based upon the shade of colouration which small quantities of sulphuretted hydrogen produce upon pure silver, or certain alloys thereof. In a glass stoppered bottle, of 25 centimetres diameter and 15 decimetres height, a mixture is poured of 1 grm. of water and ½ a grm. of concentrated sulphuric acid, to which is added 1 decigrm. of the metal reduced to the finest possible powder. There suspend, by means of a very fine platinum wire, in the bottle, without touching the fluid, a clean piece of metallic silver, the platinum wire being held squeezed between the stopper and the neck of the bottle. The metal dissolves in a moderately warm room within a quarter of an hour, so that the silver can be taken out and examined after that time. The author has, by means of a series of experiments, been enabled to construct a series of numbers, representing, according to certain shades of colouration, the quantities of sulphur found.

Drop Apparatus for Fluids.—MM. Alvergnat, Frères.—This contrivance consists essensially of a flat-bottomed glass flask, round the top portion of which a caoutchouc balloon has been so arranged, that a glass tube bent downwards outside of the flask, and reaching straight down to the bottom, passes air-tight through the balloon. When the latter is compressed, the air it contains forces the liquid in the flask upwards; and this may be so managed as to cause it to flow drop by drop out of the bent tube.

Among the papers the titles of which we notice, but do not abstract, because they are too lengthy, and do not, moreover, belong to chemical science, are the following:—

Process for the Reproduction of Pictures by Lithography and other means.—M. Mielle.

Furnace Constructed to Burn Spent Tan for the Purpose of Heating Steam-Boilers.—MM. Durand, Frères, 17, Rue de Gobelius, Paris.

December 16, 1869.

Aniline Blue.—M. Blumer-Zweifel.—When either the tartrate, or hydrochlorate of aniline is brought under the influence of oxidising substances, it produces on tissues an intensely black colour; by a somewhat analogous process, the author obtains a blue which is stated to be as good as indigo blue. For printing, 100 grms. of dry starch are mixed with a litre of boiling water, to which is added 40 grms. of chlorate of potassa, from 3 to 4 grms. of sulphate of iron, 10 grms. of chloride of ammonium, and, after this mixture is cold, 60 grms. of the aniline salt.

Vesuvine.—M. Knosp.—Under this name, the author has brought into commerce a dye material belonging to the class of aniline dyes; but no further particulars are mentioned, as regards the preparation, or mode of obtaining the dye, which is reported to be sold in the state of paste and powder. This dye yields shades of bright, as well as deep orange and bright brown, and is suitable for dyeing silk, wool, and cotton; but this latter fabric has to undergo a series of mordanting processes before it is in proper state to receive the dye.

Carbon-Japanis.—Under this appellation, there has recently come into use for the purpose of paving, instead of asphalte, a mixture of coal-tar, and some chemicals not specified, and fine dry sand; this is stated to yield a very sound, hard, durable, and, at the same time, very cheap pavement.

December 23, 1869.

Manufacture of Sulphide of Carbon.—M. Contet.—As a proof of the greatly improved mode of manufacture of this substance and its very extensive use, the anthor begins by stating that, in 1840, the kilo. of rectified sulphide of carbon cost 50 francs (£2); in 1848, M. Deiss manufactured it and sold it at 8 francs per kilo., and now it may be had wholesale at 50 centimes the same quantity. The apparatus now in use consists of vertical retorts made of the same kind of clay as is in use for glass-pots; these retorts are 1·8 metre high by 0·50 internal diameter, they are lined internally with a glaze composed of 130 parts of flint glass, 20 parts of carbonate of soda, and 12 parts of boracic acid fused together, and next pulverised and painted on the inside of the retorts with gum water (at the first heating of the retorts this mixture yields a glaze which entirely closes the pores of the material, thus preventing escape of vapours and gases); four of these retorts are set in one oven made of brichwork, and are heated by a properly constructed furnace; the retorts are provided with the necessary tubes for the abduction of the vapours of the sulphide of carbon, and the introduction of the charges of sulphur and charcoal; the operation once commenced is continuous, since the retorts last for at least six months; the consumption of sulphur per retort amounts to 125 kilos. in 24 hours, introduced in charges of 155 grms. each, every three minutes time; the vapours of the sulphide of carbon are collected and condensed in vessels made of zinc or sheet-iron, and shaped like flattened down casks, and entirely covered over with cold water constantly refreshed, while the contrivance is so arranged as to keep the sulphide under water also (its specific gravity is 1·265, and its boiling point 45°). The most suitable temperature for this manufacture is bright red heat; the raw liquid obtained has to be re-distilled, and this operation is conducted in large iron vessels, which contain some 5000 kilos. at the same time and communicate with six worm condensers; steam is used for heating by means of a serpentine-coiled set of pipes, and the liquid is heated to 48°; near the end of the distillation the temperature is raised to 100°, in order to drive off a raw product containing very much sulphur dissolved; in the distillatory apparatus some sulphur remains; which is removed and again applied; it appears that this industry has become very extended and is carried on with great success in France. This number contains the first portion of an interesting paper on the

Analysis of Several Different Kinds of Extracts of Meat.—M. Lebaique.—Which we shall leave for the present and abstract only when it is quite finished.

Lighting the Numbers of Street Doors at Nights.—M. Méne states that the researches of a chemist have resulted in the production of a fluid which is painted on the numbers and causes the same to shine and be perfectly visible even in very dark nights; the process, about the nature of which nothing further is said, is stated to be simple, inexpensive, and not dangerous or injurious in any way; experiments made on the large scale have given satisfactory results.

Annalen der Physik und Chemie, von Poggendorff, No. 11, 1869.

This number contains the following original papers:—

Researches on Mica and Minerals Associated therewith.—Dr. Bauer.

Validity of the Law of Ohm for Electrolytes and a Numerical Determination of the Resistance to Conduction of Dilute Sulphuric Acid by Alternating Currents.—MM. Kohbrausch and Nippoldt.—The concluding portion of a lengthy essay.

Studies on the Oxygen Compounds of the Halogens.—M. Kaemmerer.—In the introduction to this paper, the author suggests an alteration of the nomenclature for the following compounds in the sense thereby respectively expressed, the name now in use being between brackets:—Cl, chlorine; ClH, chloric acid (chlorsäure) (hydrochloric acid); ClHO, oxychloric acid (hypochlorous acid); $ClHO_2$, dioxychloric acid (chlorous acid); $ClHO_3$, trioxychloric acid (chloric acid); $ClHO_4$, tetroxychloric acid (perchloric acid). The paper then treats of trioxybromic acid (which was prepared by the author in pure state from trioxybromate of silver) and its decomposition by means of bromine. This acid was proved to form a definite hydrate—

$HBrO_3+7H_2O$.

Trioxychloric acid forms a definite hydrate—$HClO_3+7H_2O$. Sp. gr. at 14°2=1·282. When this hydrate is left standing *in vacuo* over sulphuric acid, the substance becomes more concentrated, and a momentary evolution of much gas takes place. This concentrated acid led to the formula $2HClO_3+9H_2O$. Trioxyiodic acid forms a hydrate, $2HIO_3+9H_2O$. Sp. gr. at 13°, 2·1269. Pure, solid, and crystalline anhydrous trioxyiodic acid: sp. gr. at 9°, 4·7987.

Comparative Scale for Spectra.—M. Weinhold.—The subject is entirely treated algebraically.

Experiments on Boiling.—M. Krebs.—The author investigates in this portion of his paper, and illustrates, by diagrams and descriptions of experiments, some of the less well-known and defined causes of steam-boiler explosions.

Mineralogical Communications.—M. G. Vom Rath.—This is the eighth part of a lengthy monograph, chiefly of crystallographico-mineralogical interest. Among the recent chemical analyses it contains, we quote:—*Oligoklase*, from Vesuvius. In 100 parts:—Si, 29·38; Al, 12·48; Ca, 2·06; K, 2·21; Na, 5·51; O, 47·06. *Andesin*. In 100 parts:—Na, 11·36; Al, 13·54; Si, 27·67; O, 47·43.

Lightning without Thunder.—T. Hoh.—The author states that the phenomenon seen by him at Bamberg (Bavaria) during the night of the 26th of July last was altogether distinct from the so-called *Wetterleuchten* (sheet-lightning), and that, although quite close to him, he did not perceive the least sound or report, which follows sharp and well-defined lightning. There was no wind, and the night very quiet. Bamberg only contains a population of about 26000; and, since the phenomenon was seen about midnight, there was no noise to prevent even thunder at a distance to be heard.

Journal für Praktische Chemie, No. 13, 1869.

This number opens with a brief obituary of the founder of this periodical, Otto Linné Erdmann, M.D., Ph.D., born at Dresden, April 11th, 1804, and who died on the 9th of October last. The deceased was Professor of Chemistry at Leipzig, and founder of this periodical in 1828. His three chief co-editors (Messrs. Schweigger-Peidel, Marchand, and Werther) all died before him. Dr. Erdmann's name is connected with many valuable contributions to science.

The original papers are the following:—

Derivatives of Propan (Propylhydride).—No author's name.—By means of a rather lengthy process, the author obtained a body, $C_3H_{14}O_4$; but how this substance originated could not be made out. The main conclusion derived from the results of the experiments is that the general method to bring secondary alcohols to primary is as follows:—The iodine of the secondary iodides is displaced by hydrogen in the nascent state. The hydrocarbon so generated is acted upon by chlorine, whereby primary chlorides are formed. When propan is chlorinated, chloride of propylen, $CH_3—CHCl—CH_2Cl$, is formed. This, the author states, could hereby be expected, since, when ethan, C_2H_6, is chlorinated, chloride of ethylen, $CH_2—CHCl_2$, is formed.

Pigment Contained in Yellow Berries.—No author's name.—The colouring matter is insoluble in water. It is named rhamnegin. Formula, $C_{24}H_{32}O_{14}3H_2O$. When acted upon by sulphuric acid, it is plit up into rhamnetin and sugar, rhamnetin, $C_{12}H_{10}O_5$, and $2(C_6H_{14}O_6)$. When rhamnegin is heated to 140° alone with anhydrous acetic acid, the result is the formation of a substance insoluble in water—

$$C_{24}H_{20}(C_2H_3O)O_{14};$$

while rhamnetin, treated in the same manner, yields a solid substance soluble in alcohol—$C_{12}H_8(C_2H_3O)_2O_5$.

New Volatile and Saccharine Substance from the Caoutchouc of Gaboon.—M. Girard.—The author finds, in the caoutchouc imported from the French settlement of Gaboon (West Coast of Africa), a substance which he calls *Dambonite*. It is a white-coloured, solid body. Taste sweet; very soluble in water; difficultly so in absolute alcohol; fuses at 190°; and may be sublimed at 200° to 210° without decomposition. In its crystalline state, its formula is $C_6H_8O_6$. When submitted to the action of fuming hydriodic acid, it is split up into *Dambose* and iodide of methyl; $C_6H_8O_6+HI=C_6H_6O_6+C_2H_3I$. Dambose is an anhydrous glucose, capable of crystallisation, insoluble in absolute alcohol.

On Rufigallic Acid.—M. Löwe.—After referring to the labours of M. Robiquet and others on this subject, the author states that, when rufigallic acid is pure, it is insoluble in water, either hot or cold, difficultly soluble in ether and alcohol, and exhibiting a red-brown powder not unlike amorphous phosphorus. Average composition in 100 parts:—C, 54·449; H, 2·697; the rest being O. Formula, $C_{30}H_6O_{18}$.

No. 14, 1869.

This number contains the following original papers:—

Contribution to the Qualitative Analysis and Detection of Dyes and Colours Imparted to Textile Fibres.—M. Stein.—This paper is to be considered as an introduction to an essay the author intends to publish on this subject, which is, indeed, a far more difficult one than is generally believed. The author gives some instances, stating that not only the material of the dye, but the duration of exposure to the dye-bath, mordants applied, the mode of cleansing (*avivage*), all concur to influence the qualitative detection of even one and the same dye material; as a general rule all dyes fixed by means of tin mordants are faster than those fixed by means of alumina mordants, and all dyes fixed without any mordant at all are more or

less easily dissolved from the textile fibres. This portion of the paper treats further on blue dyes, of which, under the heading of simple (*einfach*) four kinds are enumerated, viz., (1) Indigo applied in two different ways, so-called "vat blue" and "Saxony blue;" (2) Prussian blue or cyanogen blue; (3) Blue from various dye woods; (4) Aniline blue. Mixed blue dyes.—The different qualitative tests and the mode of their application are given at full length, of which the following is a condensed abstract:—I. Heat the material to be tested with alcohol of 80 per cent and a few drops of hydrochlorie acid. A. The material is reddened, and yields a red liquor. Blue from dye woods.—B. The material retains its blue colour; the fluid becomes blue coloured: (1) Aniline blue; (2) Saxony blue. C. The material remains unchanged; liquor not coloured: (1) Vat blue; (2) Cyanogen blue. II. Further treatment of the materials sub B and C. B. The fabrics is tested with strong sulphuric acid; no change occurring indicates Saxony blue. When the colour changes to brownish yellow or brownish red, aniline blue is present. C. Heat with a solution of soda; no change of colour occurring indicates vat blue. When, on the other hand, this reagent causes either complete discolouration or turning to yellow or brown, cyanogen blue is indicated. It should be observed that a series of confirmatory tests are required and given at length, but space forbids to enter into further particulars.

Meteoric Iron Fallen on the Collina di Brianza (Milanese Territory).—Dr. Hausofer.—The author has made a careful analysis of a piece of this very large meteorite, about the origin of which some doubt has existed. The specific gravity of this material is 7·596; it does not contain sulphur or chromium, and was found to consist, in 100 parts—of iron, 91·1: nickel, 7·7; phosphorus, 0·3; cobalt, 0·2; and traces of carbon.

Meteorite Found near Cranbourne, Australia.—Dr. Hausofer.—Specific gravity, 3·744; contains, in 100 parts—insoluble silicates, 4·1; silica, 2·3; alumina, 1·5; lime, 1·8; phosphoric acid, 1·4; protoxide of iron, 71·1; protoxide of nickel, 3·1; water, 13·7. The hardness of this substance is about the same as that of felspar.

Action of Chloro-Chromic Acid (Chromsaurechlorid) Upon Benzol.—Dr. Carstaujen.—The author first reviews the labours of M. Carius and others to obtain the direct oxidation of benzol, and then states that it occurred to him that chloro-chromic acid might be used for this purpose. The action of that substance upon benzol is, however, so violent that the chloride aforesaid cannot be used undiluted; as a diluent, liquid glacial acetic acid is used, and in this manner there is obtained, after proper purification, a substance, trichlorchinon, $C_6HCl_3O_2$. This material is crystalline, soluble in boiling alcohol, and its origin from benzol is explained by the following formula:—$4(CrO_2Cl_2) + C_6H_6 = C_6HCl_3O_2 + 2Cr_2O_3 + 5HCl$. When chloro-chromic acid contains any free chlorine, there is also formed some tetrachlorchinon and a peculiar heavy oily substance.

Combination of Tantalum and Niobium.—M. Rammelsberg.—The author has undertaken this very laborious research in order to test the correctness of the labours of Messrs. Blomstrand and Marignac on this subject, and also to vindicate the correctness of the researches of the late M. H. Rose; the headings of the chapters of this monograph are: tantalum, atomic weight of tantalum, chloride of tantalum, bromide and iodide of tantalum, fluorides and double fluorides of tantalum, tantalic acid, salts of tantalic acid, lower oxides of tantalum, nitride of tantalum; this paper is to be continned.

On Chrysophanic Acid.—Dr. Rochleder.—After referring at some length to the labours of many chemists, as well as those made by himself on this subject some years ago, the author enters into a discussion on the statements made by MM. Graebe and Liebermann respecting the composition of chrysophanic acid, and then says, that he has taken the trouble to prepare this acid in pure state from rheine as prepared by Dr. Marquardt at Bonn; this substance consists mainly of chrysophanic acid, emodine, and impurities; the composition of pure emodine dried at 100° is, in 100 parts, C, 65·75; H, 4·29; O, 30·18; formula: $C_{40}H_{30}O_{18}$; the formula which Messrs. Graebe and Liebermann give for chrysophanic acid, viz., $C_{14}H_8O_4$, cannot, according to the author of this paper, be the correct one, and this the less so, as no less than six different chemists have found for rhe formulæ of this substance, prepared from different sources and at various periods, the formula, $C_{56}H_{44}O_{17} = 4(C_{14}H_{10}O_4) + H_2O$, because the H_2O of crystallisation is only driven off at 115°; it should be kept in view that emodine is very difficult to separate from chrysophanic acid, and M. Rochleder suspects that the statements of Messrs. Graebe and Leibermann about the action of pulverised zinc upon chrysophanic acid are vitiated by the presence of emodine in the acid used for these experiments.

On Toluylendiamine.—M. Koch.—This substance, a bye product of the manufacture of aniline, is readily and rather violently acted upon by anhydrous acetic acid, the result being the formation of diacetyltoluyldiamine:—

$$\underbrace{C_7H_4\begin{Bmatrix}NH_2\\NH_2\end{Bmatrix}}_{\text{toluyl-diamine.}} + \underbrace{\begin{Bmatrix}C_2H_3O\\C_2H_3O\end{Bmatrix}O}_{\text{anhydrous acetic acid.}} = H_2O + \underbrace{C_7H_4\begin{Bmatrix}NHC_2H_3O\\NHC_2H_3O\end{Bmatrix}}_{\text{diacetyl-toluylendiamin.}}$$

Tl is latter compound yields, on being heated to 150° with 1 eq. of carbonate of soda, an acetyl, and is thereby converted into monoacetyldiamine; the diacetyl compound is, by the addition of bromine, converted into monobromodiacetyltoluylendiamine,

$$\left(C_7H_3Br_7\begin{Bmatrix}NHC_2H_3O\\NHC_2H_3O\end{Bmatrix}\right)$$

a solid substance crystallising in needle-shaped crystals, when this compound is heated to 130° along with an excess of caustic potassa solution it is converted into monobromoacetyltoluylendiamine.

Les Mondes, December 23, 1869.

Estimation of the Value of Sugars for Commercial Purposes.—M. Méhay.—The author proposes that the brokers should supply standard samples of refined sugar, which should be considered as pure, for all commercial purposes, and that every assay, of any kind of sugar, whether made by means of the optical saccharimeter or by the Frommherz-Barreswil process, should be compared with an assay of the standard sample made at the same time. The samples of raw sugar marked from No. 1 to 21, adopted by the Netherlands' Society for Trade and Commerce, have been found, by repeated assays, to represent very accurately the value, and each to contain, according to the specific number, the percentage of pure sugar found therein by rigorous analytical methods; and with these samples properly marked and guaranteed genuine any analyst can be supplied by brokers. On the Continent, raw sugars are generally denominated No. 80 and so, by which the different qualities are readily discriminated, bought, and sold.

Falling Stars.—The Rev. Father Denza, S.J.—A very interesting and extensive account of observations made at nineteen different places in Italy, from Palermo to Moncalieri and Milano, giving for every locality the number of meteorites seen and observed at observatories during a given time.

Obituary.—The well-known scientific chemist, Stephane Robinet, who was born at Paris, on the 6th of December, 1796, died at that city on the 3rd of December, last. The deceased is especially known for his zeal in analysing the natural waters of France, and for his excellent hydrographical works.

Cosmos, December 25, 1869.

Permeability of Caoutchouc Tubes.—M. Jouant.—The author states that, from a series of experiments he has made, the following conclusions may be drawn:—A vulcanised caoutchouc tube of 1·2 m.m. thickness, and having a surface of 33·60 sq. m.m., loses, in three days, by diffusion, 21·3 per cent of hydrogen, while 11·2 per cent of air has at the same time entered. That the non-vulcanised caoutchouc tubing is by far less permeable for gases is proved by the following facts:—A tube of the last-named substance, having 50·00 sq. m.m. surface, has been submitted to the same experiment during twenty-eight days, and lost during that time, by diffusion, 22·6 per cent of hydrogen, while only 5·6 per cent of atmospheric air entered the apparatus, which was arranged precisely alike for both experiments, and so constructed as to indicate any change of pressure going on internally by means of manometer tubes. The permeability of caoutchouc for gases is a well-established fact, and a consequence of its peculiar structure.

NOTES AND QUERIES.

Alumina from the Island of Eubæa.—Can any of your correspondents inform me about the "Alumina" obtained from the Island of Eubæa, its price, and through whom it may be obtained. Samples required, which would probably lead to business.—J. E. N.

Dissolving Resin in Water.—(Answer to J. Milton).—You cannot dissolve resins in water as you can salt, or sugar, or gum; but shellac, for instance, may be rendered soluble in water by means of a solution of borax, and by means of aqueous solutions of caustic and carbonated alkalies, many (not all) resins may be rendered what can be termed soluble in water; but in reality this is attended with a kind of saponification similar to that which occurs when neutral fats are treated with caustic alkalies, thereby becoming soluble soaps.

MEETINGS FOR THE WEEK.

MONDAY, 10th.—Medical, 8.
TUESDAY, 11th.—Photographic, 8.
WEDNESDAY, 12th.—Society of Arts, 8.
—— Microscopical, 8.
THURSDAY, 13th.—London Institution, 7.30.
—— Royal, 8.30
—— Zoological, 8.30.
—— Royal Society Club, 6.
FRIDAY, 14th.—Quekett Club, 8.

TO CORRESPONDENTS.

L. Nightingale.—Any good work on agricultural chemistry will give you the information you seek.

V. A. U.—The copyright will belong to the proprietor of the magazine, unless you stipulate for its reservation when sending the article.

H. H.—1. Some excellent lectures on coal-gas appeared some little time ago in the CHEMICAL NEWS: consult these. 2. Mulder on the "Chemistry of Beer."

James Wylde's courteous letter in reference to the *Electric Telegraph Review* is received, with thanks, and shall meet with due attention.

R. C. Moffat, Ph.D.—1. The index is issued with the present number. Its great length and the care required in its preparation have rendered the delay of a week necessary. 2. Browning and Co., Minories, or Horne and Thornthwaite, Newgate Street.

THE CHEMICAL NEWS.

Vol. XXI. No. 529.

ON A MINERAL FROM SAN PAOLO.

By Dr. T. L. PHIPSON, F.C.S.,
Member of the Chemical Society of Paris.

A mineral from San Paolo, Brazil, was placed in my hands a short time ago in Paris; it was supposed to be a silicate of yttria, and was called Thelline or Thellite. It corresponded in appearance and properties with the silicate of yttria, described by M. Damour, in 1858, as having been found in the diamond sands of Bahia, Brazil; a brown mineral, said to be "probably a silicate of yttria," which whitens before the blowpipe, but does not fuse, and was found to be insoluble in phosphorus-salt.

A small sample of the specimen from San Paolo was confided to me for analysis, with a request that I would make known the result at an early opportunity.

The following is a description of the mineral and its analysis:—It is of a light brown colour, translucent on the thin edges, and in the veins which traverse its substance; when pulverised it gives a light yellow powder of great brilliancy, which becomes bright red when heated; it is partially attacked by strong acids. Before the blowpipe it is infusible, but darkens and turns black in the inner flame, and, by continuing the heat for some time, the surface becomes quite white. It scratches glass like a diamond, and cuts it very nearly as easily as the latter, but it will not attack quartz; it gives flashes and sparks of fire when struck smartly in an agate mortar; it is quite devoid of crystallisation, and its fracture is imperfectly conchoidal. No trace of yttria could be obtained from this mineral, but it was found to contain about 1 per cent of glucina as an accidental constituent. It yielded—

Silicic acid	90·90
Water	4·54
Peroxide of iron and alumina with about 1 per cent of glucina ..	4·56
	100·00

The presence of glucina in this mineral, which is evidently a kind of hydrated silica, menilite, or resinite, is rather interesting, and leads me to believe that this earth will be found in other natural kinds of silica. Silicate of glucina (Phenakite) is so closely allied to quartz in appearance and crystalline form that it is easily mistaken for it, and substances possessing, when crystallised, the same crystalline form are often found together in nature. I do not conclude from the above that the mineral I have examined is identical with M. Damour's silicate of yttria, for I am not aware that I have ever seen the latter. Doubtless he will some day publish an analysis of it.

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BEET-ROOT SUGAR.

When the Berlin apothecary, Marggraf, in the year 1747, made known, at a meeting of the Royal Prussian Academy of Sciences, the fact that the beet-root contained sugar identical with that derived from sugar-cane, and that he had obtained, by means of alcohol, 6·2 per cent of sugar from the white variety of beet, and 4·5 per cent from the red-coloured root, he certainly did not dream that, within a century after his discovery, the manufacture of beet-root sugar would have become one of the most extensive of what is very properly termed, in the German language, *landwirthschaftliche Gewerbe*, but for which no very good translation can be given. It is too much the fashion to take it for granted that manufacturing industry ought to be chiefly confined to larger centres of population; but this notion is not entertained on the Continent, where, beside beet-root sugar making, the preparation of madder and various derivatives therefrom is conducted in the country, rather than in towns. This is also the case with the distillation of spirits from wine, as well as that obtained from various other sources—viz., potatoes, beet-roots, cherries, &c.

The proposals made by M. Marggraf to obtain sugar from beet-roots on the large scale did not then meet with any success, owing to a variety of concurrent causes, among which may be mentioned the cheapness of cane-sugar, imported into Germany from this country and Holland. About the end of last century, Messrs. Achard and Hermbstädt again called attention to this subject, and succeeded on a sufficiently large scale in obtaining from beet-roots about 6 per cent of crystallised sugar and 4 per cent of molasses. It was, however, mainly due to the political disturbances and wars of the latter end of the last and the first fifteen years of the present century that the manufacture of beet-root sugar was entered into commercially. This was principally due to the encouragement of Napoleon I., aided by the eminent judgment and sound scientific knowledge of one of his ministers—the famous Chaptal. It is true that, almost immediately after Napoleon's fall, the beet-root sugar industry collapsed—but only to be revived on sounder scientific and mercantile principles, its temporary collapse being partly due to the protective tariffs made in favour of colonial sugars; whilst, in some countries, beet-root sugar making was practically prohibited, also, by absurd and injudicious excise regulations.

The plant known as *Beta maritima* (an unsightly bi-annual vegetable, which grows wild on the coast of the Mediterranean in Spain, Dalmatia, and some parts of France) is the mother plant from which the sugar-yielding beet has been derived. The well-known red beet is a different variety of the same genus. The beet has been an object of regular cultivation as a suitable cattle-fodder only from the beginning of this century, since which time several varieties have been obtained, partly as a result of cultivation, partly, also, as a consequence of climate and soil. The *Beta cicla*, or so-called white Silesian beet-root, is considered by many as the best variety for the production of sugar. This root, as well as the other varieties, is a biannual plant. The first year after sowing it only produces rootlets and leaves; in the second year of its growth, the root becomes developed; and, were it not that this vegetable cannot very well stand frost, the best period for its gathering would be in the spring following its second winter. This condition, however, cannot be complied with, and the crop is gathered in the autumn. The weight of the crop of roots gathered from one hectare varies, as might be expected, considerably; but the following figures may give some idea of this subject:—In Austria, from 416 to 580 cwts., yielding from 3080 to 4336 lbs. of sugar; Bohemia, from 448 to 580 cwts., yielding from 3344 to 4640 lbs. of sugar; Prussia, about 720 cwts., yielding about 5344 lbs. of sugar; France, 596 cwts., yielding 4464 lbs. of sugar. The composition of a good kind of the *Beta cicla*, in 100 parts, is:—Water, 83·5; sugar, with a trace of dextrine (about 0·1), 10·5; ligneous fibre, 0·8; albumen, casein, and other albumenoid substances, 1·5; fatty matter, 0·1; organic substances—viz., pectine, citric, and pectic acids, a substance which, in contact with air, assumes a rose colour, asparagin, oxalates and pectinates of lime, potassa, and soda; inorganic salts—viz., nitrate and sulphate of potassa, chloride of potassium, phosphate of lime, and magnesia, all together, 3·7 per cent. It is evident that the juice obtained from a plant of that complex composition is a somewhat difficult fluid to deal with for obtaining sugar therefrom; and, in order fully to illustrate the triumph of well-applied science in this respect, we quote, for compari-

son's sake, the percentage composition of sugar-cane:—Sugar, 17·8; water, 72·0; cellulose, 9·8; saline matter, 0·4.

There are various processes in use for obtaining sugar from beet-root; but the following is an outline of the general mode of operating:—The roots are dug up, and the head bearing the leaves (which serve together as fodder) is cut off commonly on the field. The roots are then carted to the sugar works, and there washed by machinery, it being essential that neither clay nor pebbles should remain adhering, since these might injure the machinery by which the roots are next made into pulp, by being torn up by very sharp circular saws, placed close together on a revolving cylinder, making from 1000 to 1200 revolutions per minute. The pulp is placed in bags made of a very strong linen tissue, and from twenty-five to fifty of these bags are placed on each other on the movable plate of a hydraulic press, care being taken to place between every two bags a frame wicker-work or perforated tinned-iron plates. The pressure, which can be applied averages from 500 to 700 lbs. per square inch; generally the pressing process is repeated, sometimes with, sometimes without previous moistening of the cake, which, in some cases, is also broken up again. Before we follow the juice obtained by this pressure, we may pay a moment's attention to the cake obtained after it has been submitted to repeated pressure. It exhibits a hard, somewhat plank-like appearance, varying in size with the size of the press-plate, and about ½ or ¾ of an inch thickness. It contains, according to an analysis made at Hohenheim*:—Water, 15·61; ash, 1·27; cellulose, 1·47; sugar, 1·72; carbohydrates (starch, &c.), 2·84; proteine compounds, 0·28; together, 23·2. To which add, to make up the 100 parts of beet-root, 76·8 per cent of juice, containing:—Water, 65·95; sugar, 10·17; carbohydrates, 0·63; proteine compounds, 0·58. The cake is used as fodder for cattle, or, in some cases, for the manufacture of brandy, vinegar, and, last, but not least, for the manufacture of paper, for which it is increasingly in demand.

The juice, as it runs from the press-plate, is led, by means of gutters, to what is termed a *monte-jus*, and by its means (by steam) forced up to the defecation-pan, wherein it is rapidly heated, by means of steam (the pan being jacketed), to 85°. This temperature having been reached, a thin milk of lime is added, and the fluid thoroughly stirred up. The lime saturates the free acid present in the juice, and precipitates as well as decomposes the albuminous substances, ammonia being consequently evolved. In order that the lime should act properly, it is necessary to increase the heat, which is raised to near the boiling point of the fluid. The quantity of lime added depends upon the quality of the roots, but is generally about from 1 to 2 lbs. for every 100 litres of juice. The liquor in the defecation-pan is run off clear from the supernatant scum, by means of an ingeniously-contrived tap, and, previous to reaching the animal-charcoal filters, the fluid is filtered through a peculiar kind of flannel, made on purpose. The defecated juice is not a pure solution of sugar; it contains saccharate of lime, free sugar, free potassa, soda, and some ammonia; small quantities of organic nitrogenous substances, and sulphate and nitrate of potassa. The removal of a portion of these impurities is effected, in many instances, by filtration through animal charcoal, next submitted to the action of a current of carbonic acid, whereby the saccharate of lime is decomposed; and the clear liquid is evaporated to a density of 24° to 25° Beaumé (sp. gr., 1·199 to 1·210), and again filtered over animal charcoal, in order to remove from the liquid (technically, *clearsel*) colouring matter and other impurities. The filtered juice should have the colour of pale sherry, and be free from any suspended impurities. The filtered liquor is next evaporated to a density of about 42° Beaumé (sp. gr., 1·412). This evaporation is best performed in a vacuum-pan. When the proper degree of concentration has been attained, the thickish magma (a mixture of cystallised sugar and syrup or molasses) is run into a copper pan, technically termed a cooler; but this is in so far a misnomer, as the contents of the pan are heated by steam to a higher temperature (above 120°) than was attained in the vacuum-pan. The contents of the pan are kept in constant motion, by means of stirring, while a gang of men are busy carrying the pasty mass to the sugar-loaf forms, in order therein to solidify, and to be deprived of adhering syrup by being washed with a solution of pure sugar, sufficiently concentrated for it not to dissolve any crystallisable sugar, while effectually removing the molasses. Instead of this rather expensive process, which yields refined sugar, it is often omitted, and in its stead is substituted the use of the centrifugal machine, or, also, of the so-called Schutzenbach boxes (iron tanks, with a false bottom made of wire-gauze, upon which the magma, after it has been heated in the coolers, is run), and there left for several days, until the molasses have entirely run off; the produce being raw beet-root sugar, which is not fit for consumption until it has been refined, even if its colour is only pale yellow.

The molasses from beet-root sugar are unfit for use as swetenings, owing to the large quantity of mineral salts they contain. According to Meitzendorf, these molasses consist, in 100 parts, of:—Water, 10·8; mineral salts, 10·5; proteine compounds, 9·8; sugar (cane-sugar and non-crystallisable sugar), pectin, fatty matter, caramel, and other undetermined organic substances, 68·9. This material is employed for the manufacture of spirits, which, however, are not at all agreeable to the palate, but might be rendered pure by re-distillation with quicklime and the use of freshly-ignited wood-charcoal. The residue of this distillation is a valuable source of potash. In Russia and some parts of Silesia, the molasses are used, along with other fodder, for the cattle—a practice which deserves encouragement.

The Continent of Europe contains 1184 beet-root sugar works situated in Germany, France, Russia (inclusive of Poland), Austria, and Belgium. There are, perhaps, scattered over the rest of Europe, some dozen of these works yet; but their production does not materially add to the 4,475,000 cwts. of beet-root sugar annually produced by the works above named. It is evident that, in countries where labour is cheap, and whose inhabitants, but for the beet-root, would be dependent for their supply of sugar upon countries which possess colonies, or dependencies where sugar-cane can be grown, the cultivation of beet-roots intended for the manufacture of sugar is a decided boon. In some cases, objection may be raised to this industry, since it cannot be denied the extensive culture of such crops as, for instance, beet-root, tobacco, madder, &c., may interfere, to some extent, with the cultivation of cereals. Yet, however cogent this objection (which has, also, been several times brought forward against the extensive cultivation of sugar-cane in hot climates), it is an undeniable fact that the rural populations in Europe derive great benefit from this industry, which keeps them suitably employed during the winter months of each year; and the results obtained fully prove that beet-root sugar can hold its ground, and compete successfully with colonial sugar when placed on equality therewith.

As regards the United Kingdom, it cannot but cause some astonishment, that a country ranking first in agriculture, and doubly so in everything relating to manufacturing industry, should have hitherto lagged behind in the successful carrying out of this industry—a fact the more to be wondered at since the cultivation of root crops is very extensively carried on, and the beet-root residues may serve as food for cattle even better than the roots purposely cultivated for that purpose. Agricultural labourers can (as instanced by Continental experience) be readily taught the operations of the beet-sugar manufacture; and the skilled

* This place is situated near Stüttgart, in Wurtemberg, and is one of the largest and the best conducted agricultural colleges in Europe. It is fitted up, not only for theoretical, but also for practical, instruction, and contains a model beet-root sugar work, brewery, distillery, and other manufactories belonging to the class termed, in Germany, *Landwirthschaftliche Gewerbe*, on a sufficiently large scale for practical use.

supervision does not require more than, at the utmost, half-a-dozen men. In France, Belgium, and Germany, women, as well as men, are employed in these works. As to climate, excepting the central and northern parts of Scotland, and the high moor grounds, the United Kingdom is as favourably situated for the cultivation of beet-root for sugar manufacture as any portion of the European Continent; while the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing system of rotation. As regards the duty on sugar, this is now equalised with that payable in the neighbouring countries—France, Belgium, and the Netherlands. So that, if this matter were to be properly taken up, and economically carried out, with due foresight, and there were brought to bear upon it that practical scientific knowledge which has raised, on the Continent, this industry from a puny infancy to the full strength of vigorous manhood, there is no doubt that it may become a source of great improvement and well-being to the rural population of this country.

ON THE

MANUFACTURE OF CRUCIBLE STEEL.

By R. H. SMITH, F.C.S., &c..

A GREAT deal is being talked about the production of cast-steel directly fron iron ores, or its manufacture from inferior kinds of English iron; but little is known or said (outside the immediate manufacturing districts) as to how the immense quantities of this substance are produced at the present time. The conversion of iron into steel is, perhaps, to be classed among one of the most peculiar, but, at the same time, interesting, processes with which chemists are acquainted.

The ordinary converting furnaces are of a conical shape, the bar-iron laying in stone pots, in contact with charcoal; and the heat to which the iron is exposed is regulated according to the purpose for which it may afterwards be required. The time generally occupied in what is termed "conversion" is about three weeks, a week being taken to raise the heat to a sufficient degree, a second to maintain it at the required temperature, and a third to gradually cool the furnace. When cold, the bars are withdrawn, and found to be covered with blisters, and, if broken, possessing a fracture totally different in appearance to that shown by the iron before treated in the manner described. Several tempers, as they are technically called, are produced in one furnace, and much care is necessary in selecting them out for the different requirements of the melter.

Too much care cannot be taken in the melting of steel, as the after work so much depends upon this part of the process. The melting-holes are on a level with the floor of the furnace-room. Each hole has a flue; and some six, twelve, or more, of these form a flat stack. The grate bars at the bottom of each hole are approached by means of a cellar below. The crucibles, or pots, as they are called, made from a mixture of several kinds of clay and a little coke-dust, are formed into shape by means of a plug and flask. The pots are annealed over night, and, when at a dull-red heat in the morning, placed in the holes by means of tongs, each furnace taking two pots.

The bar-steel of the required hardness is now broken up, and the crucibles charged by means of an iron funnel. The first heat, as it is called, will take from four to five hours before it is ready to be poured; but this greatly depends on the nature and hardness of the steel. The holes are watched and worked by the puller-out; but the word to draw the pot is given by the melter.

The puller-out now lifts the crucible from the hole with large tongs, and places it upon the floor of the furnace. Its contents are then poured by the melter into a mould, made of cast-iron in two pieces, covered with a coat of coal-tar soot, and held together by rings and wedges.

Great care is required in pouring, or teaming, the steel, as it is technically called, and skill in judging the proper heat when to cast it. Mild or soft steel should be teemed immediately the pot is withdrawn from the furnace; but hard steel may often remain a few minutes with advantage. Each crucible should last one day, and is used three times, with charges of 50, 45, and 40 lbs. respectively.

All steel above a chisel temper contains 0·90 to 1·00 per cent of carbon. If well melted it will settle down in the mould, leaving a small hole at the top of the ingot. If, however, the molten steel has not remained long enough in the fire, it will pour fiery; and, if the ingot, on cooling, be broken, it will be found to be full of small holes, called honeycombs. Great precaution must also be used in not allowing the metal to remain too long in the fire, as hard steel, when of good quality, will soon scorch, and so render the ingot very brittle.

Well melted steel (say of a tool temper) may be thus known. The ingot will be of a blue colour, with a smooth and even skin; the fracture of uniform brightness, and the outer edge perhaps slightly scorched.

Another very important operation to which steel is subject is the hammering; and probably more good steel is spoiled in this department than any other. The ingot should be well soaked in the flame of the forge-furnace, and not at once (as is often the case) put into a dead fire—where the heat is what is called "dead," and where no flame surrounds the ingot.

The fineness of the fracture of a bar of finished steel greatly depends upon the heat that the bar is allowed to retain when the finishing-stroke of the hammer is upon it. Coarseness and fineness of grain, as judging the temper or quality of cast-steel, is far over-estimated. It is, to a certain extent, an indication of hardness; but so much depends upon the way the bar has been finished, that it is of little practical value. However, best cast-steel, especially when hard, will show a fracture of a silky nature; and, when soft, will look bright, and shine like glass. Common cast-steel, on the other hand, will lack that brightness which is so characteristic of good steel; it will look dull, and have, so to speak, a leaden appearance about it.

In the working of steel, too much care cannot be bestowed; and, where (as in razor-making) the workman is required to use a steel containing about 1·50 per cent of carbon, the durability of the razor will almost entirely depend upon the heat to which he subjects it while forging it into shape.

A useful "tool-steel" will contain about 1·2 to 1·35 per cent of carbon. Spindle-steel, or large-size turning tools, will work well if containing about 1·15 per cent of carbon. Chisel-steel is a temper much used, will harden at a low heat, and possesses great toughness. Steel of 0·85 to 0·75 per cent of carbon will weld easily, and is adapted for "cold setts," or tools where the principal punishment is on the unhardened part.

In melting, charcoal is largely used when the bar-steel is not of the required hardness. Wolfram and titanium are occasionally used, but with little advantage.

Binoxide of manganese is univerally employed. It forms a good flux, and protects the molten-steel from the action of the air.

Spiegeleisen is much used in Sheffield. It is an alloy of iron with manganese and carbon. The following is an analysis of a good spiegeleisen:—

Iron (by difference)	84·78
Manganese	10·21
Carbon	5·01
	100·00

Among the many irons employed in steel-making, none have acquired the reputation that those imported from Sweden have won for themselves, and especially those known as the Dannemora marks.

Such brands as Double Bullet (OO) and hoop L (L) command a high price, and are much used where the best quality steel is required. Second Swedes, such as Wand Crown, Steinbuck, Great S, K6, &c., are good bodied irons, largely employed, and making a very good steel.

Of the commoner marks may be quoted (CW) $\overset{m}{\text{(SV8)}}$ Spider, and $\overset{\Omega}{\text{FG}}$; and, where a high price cannot be obtained for the steel, such brands are recommended, being found to melt and work well. English irons and spring ends are also melted, but make an inferior quality of cast-steel.

The following is an analysis of tool-steel:—

Iron (by difference)	88·34
Carbon	1·31
Manganese	0·12
Silicon	0·19
Sulphur	0·03
Phosphorus	0·01
	100·00

ON THE

TESTING OF MANGANESE ORES.

By BENJAMIN H. PAUL, Ph.D.

The question raised by Sherer and Rumpf* as to the practice of representing the value of manganese ores by the amount of binoxide of manganese actually contained in them, or equivalent to the other peroxides of manganese which are sometimes present in such ores, is one that will, no doubt, attract the notice of chemical manufacturers. And the suggestion that the value of manganese ores should be measured by chlorometrical degrees, rather than by the actual percentage of binoxide, has a tendency in the same direction as the resolution† passed by the Association of Alkali Manufacturers, last year, in reference to this subject.

The decision then adopted by the Association would seem to have been based more upon differences found, in practice, to exist between working results and the indications of tests made for determining the percentage of manganese binoxide in sample, rather than upon any probable or ascertained cause of variation in the results obtained by the method of Fresenius and Will. It would seem, also, to indicate a desire on the part of manufacturers that tests of manganese ore should express the amount of binoxide *available* for liberating chlorine, and not the amount *actually* present in the ores. It is in this respect that the iron method has an advantage over the method of Fresenius and Will, since the presence of iron as metal or protoxide in manganese ore would affect its power of liberating chlorine. The result of a test of such manganese ore by the iron method would be correspondingly affected; but that would not be the case if the method of Fresenius and Will were adopted in the testing.

Much of the discrepancy between the results of tests of manganese ore, and many of the disputes that have arisen as to the percentage of these ores, may, in all probability, have been due to the circumstance mentioned above; and, to provide against a recurrence of such differences, it would seem desirable that, in regard to a certain class of manganese ores, some other mode of testing than that of Fresenius and Will should be agreed upon, so that the valuation of those ores may be based upon the available binoxide, and not upon the actual amount.

* Chemical News, vol. xx., p. 302.

† 'That, as the testing of manganese according to the method of Will and Fresenius is, in the opinion of the meeting, incorrect, and yields uncertain results, it is recommended to members of this Association not to buy by that test."

That form of the iron process in which chloride of iron is used does not appear to be suitable for this purpose, on account of the possible loss of chlorine which may take place in the operation; but Bunsen's method of dissolving the ore with hydrochloric acid, passing the liberated chlorine into iodide of potassium solution, and determining the iodine liberated, would probably answer the purpose.

However, there is reason to believe that Sherer and Rumpf have overlooked another circumstance which must be considered in regard to the method of Fresenius and Will. With certain limitations, there is little doubt that this method gives results which are uniform, especially if the manganese ore tested in that way is of German origin, or if it resembles the German ore in being soft and readily soluble; but many varieties of manganese ore now in use are not of that kind. The Spanish, Nova Scotian, and Californian ores, for instance, are often excessively hard, and, even when finely powdered, difficult to dissolve thoroughly. In testing such ores by the method of Fresenius and Will, there is, in the first place, a risk of incomplete solution, which would make the result too low. If heat be applied to the apparatus in order to render solution complete, there is, in the second place, a risk of driving off water, which would make the result too high.

In some instances, the differences that have obtained between the results of tests could not be referred to the presence of iron as metal or protoxide in the ores, inasmuch as Fresenius and Will's method, has, in those cases, been used by the several operators, and it is probable that those differences arose from the difficult solubility of the ore. But, however that may be, it seems no longer admissible to use that method for testing manganese ores generally, although there is no reason to doubt the uniformity of its results when applied to the soft kind of ores formerly in use almost exclusively.

For these reasons, and on account of the long time requisite for dissolving manganese ores of this kind, the method of Fresenius and Will is not well adapted for testing them. For some time past, therefore, I have adopted Mohr's method of using a known quantity of a standard solution of oxalic acid, together with excess of sulphuric acid, for dissolving the ore; if necessary boiling until the ore is completely dissolved, and then, by means of a standard solution of permanganate, determining the quantity of oxalic acid remaining undecomposed. This method is very convenient for testing manganese ores, and since it involves only one weighing for each test, the source of error is less than in the method of Fresenius and Will. The results obtained are also very uniform.

This method has also the advantage of giving results which fairly represent the amount of available binoxide in manganese ores; for any iron that may be present as metal or protoxide would consume an equivalent quantity of permanganate solution, and thus apparently reduce the quantity of oxalic acid decomposed by the binoxide to an extent proportionate to the amount of iron existing in the ore. Thus, for instance, if the quantity of oxalic acid decomposed by 100 grains of manganese ore free from iron or protoxide of iron were 109·53 grains the ore would contain 76·5 per cent binoxide and the whole of that would be available. But, if the 100 grains of ore also contained 5·6 grains of metallic iron, or an equivalent of protoxide, the permanganate solution required for peroxidising that iron would represent 6·3 grains of oxalic acid, and the quantity of oxalic acid decomposed by the binoxide would appear so much less than it really was, or 103·23 grains instead of 109·53 grains. Accordingly, the amount of binoxide would be represented as 72·1 per cent, instead of 76·5 per cent; and that would, in fact, be the amount of binoxide available for generating chlorine.

This method of testing recommends itself by its simplicity, and by the fact that the standard solutions of

oxalic acid and permanganate will keep for a long time without alteration of value.

The oxalic acid solution contains 63 grms. in the litre, and 1 c.c. is equivalent to 5 c.c. of the permanganate solution.

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ON THE

SIMULTANEOUS OCCURRENCE OF A SOLUBLE LEAD SALT AND FREE SULPHURIC ACID IN SHERRY WINE;

WITH OBSERVATIONS ON THE SOLVENT ACTION OF ALCOHOLIC SALINE SOLUTIONS UPON SULPHATE OF LEAD.*

By Professor F. H. STORER.

SEVERAL years since, I was called upon by a wine-merchant of this city to examine a sample of pale sherry taken from a cask which had been returned to him, on the certificate of a chemist that the wine contained lead. The sample in question was perfectly transparent and clear. There was nothing in the appearance or taste of the wine to indicate the sophistication to which it had really been subjected.

On submitting this sherry to chemical analysis, I found not only that it held in solution a considerable proportion of lead, but also a decided trace of free sulphuric acid, besides an abundance of the same acid combined with some alkaline base. When a portion of the wine was evaporated in contact with slips of paper, the latter soon became crumbly and friable.

Regarded merely from the chemical point of view, without reference to its manifest bearing upon questions of hygiene and jurisprudence, the simultaneous occurrence of a lead salt and of free sulphuric acid in alcoholic solution is a fact sufficiently important to merit close attention. Unfortunately, the small sample of wine given me was completely exhausted in the severe confirmatory tests by which the results above mentioned were controlled, and I have had no opportunity to determine the precise manner in which the lead was held in solution in that particular case. Several conjectures as to the cause of the phenomenon will be discussed below.

That lead compounds should still be employed in the treatment of wine will surprise no one familiar with the tenacity with which traditions are held by successive generations of operatives in many of the chemical arts. According to Taylor,† "litharge was formerly much used to remove the acidity of sour wine and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause; . . . . the adulteration was discovered by Fourcroy, and was immediately suppressed."

Beckmann in his "History of Inventions"‡ dwells at some length on the antiquity and enduring character of the practice of neutralising the acid which spoils wine by means of litharge. According to this author, the practice was forbidden by legal enactment in France as early as 1696, but a hundred years later "the art of improving wine by litharge was taught in England as a method perfectly free from danger."‖

The sulphuric acid in the sample of wine examined by me was probably added, with a view of removing the dissolved lead resulting from the previous use of litharge. It is not unlikely that the addition of the free acid was preceded by that of a solution of sulphate of ammonium.

In seeking for an explanation of the fact that a certain proportion of lead may remain dissolved in wine, even in presence of free sulphuric acid, the following hypotheses suggest themselves:—

1st. It seemed not impossible, in case a mixture of weak alcohol, dilute sulphuric acid, and sulphate of lead was left to itself for a long time, that a part of the lead salt might be changed to sulphovinate of lead and pass into solution. This idea was sufficiently improbable in view of the known facts that dilute alcohol and weak sulphuric acid are unfit for making sulphovinic acid, and that but little, if any, of the acid can be formed even from tolerably concentrated liquids, unless the mixture of alcohol and sulphuric acid be heated artificially. The idea was, nevertheless, put to the test of experiment, as follows:—

100 c.c. of alcohol of 59 per cent, 5 c.c. of oil of vitriol, and a quantity of recently precipitated sulphate of lead were placed in a stoppered bottle, and the mixture was frequently shaken during an interval of three months. The clear liquid was then decanted, diluted with water, and saturated with sulphuretted hydrogen gas. Not the slightest colouration indicative of lead was produced.

100 c.c. of similar alcohol, mixed with sulphuric acid, sulphovinic acid, and sulphate of lead, gave no reaction for lead when tested after the lapse of three months.

2nd. Though the idea seemed highly improbable, it was still possible that the sugar in the wine might in some way exert a solvent action upon sulphate of lead. It was found, however, when 100 c.c. of alcohol of 59 per cent and 5 c.c. of oil of vitriol, together with a quantity of sugar and of precipitated sulphate of lead, were left to themselves for three months, that the clear supernatant liquid held no trace of lead in solution. For that matter, it was found that a mixture of sulphuric acid and much sugar-water was capable of precipitating all the lead even from an aqueous solution of acetate of lead. The filtrate from the sulphate of lead thus precipitated gave absolutely no indication of lead when tested with sulphuretted hydrogen, not even when a considerable quantity of the liquid was evaporated to dryness, incinerated, treated with nitric acid, and again evaporated before applying the reagent.

3rd. The most probable hypothesis of all, however, was, that a certain proportion of lead could be held dissolved in presence of sulphuric acid, even in an alcoholic solution like wine, by the action of various soluble alkaline salts capable of decomposing and of being decomposed by sulphate of lead; for it is a well-known fact that very considerable quantities of sulphate of lead can be held dissolved in water by means of many acetates, citrates, and tartrates, and by various other salts.

To test this idea, the following set of experiments has been carried out at my suggestion by Mr. A. H. Pearson, of Haverhill, a student in the Laboratory of the Massachusetts Institute of Technology.

A considerable quantity of dilute alcohol, of the usual strength of sherry wine (18 per cent) having been prepared, standard solutions of acetate of lead, of sulphuric acid, and of sulphate of ammonium were made by dissolving weighed quantities of these substances in portions of the 18 per cent alcohol. Each of the solutions was made of such strength that 500 c.c. of the liquid contained one-tenth of an equivalent of the salt or acid, reckoned in grammes, on the hydrogen scale.

Alcoholic solutions of several salts of ammonium and of the fixed alkalies were also prepared, as will be described below.

In each experiment, equal quantities of the standard solution of sulphuric acid, or of sulphate of ammonium, and of the saline solution to be tested were mixed in a glass flask, and the standard solution of acetate of lead was made to fall from a burette drop by drop into the mixture until a persistent precipitate of sulphate of lead

* Communicated by the Author.
† "On Poisons," p. 502 of the London edition.
‡ "Chapter on Adulteration of Wine."
‖ William Graham's "Art of Making Wines from Fruit, Flowers, and Herbs." London, sixth edition.

was perceived. The burette was graduated so that two drops from it were equal to one-tenth of a cubic centimetre; and the flask was constantly shaken while the drops of acetate of lead were falling into it.

The results of the experiments are as follows:—

Acetate of Ammonium was prepared by neutralising ordinary acetic acid with ammonia-water, and the strong aqueous solution thus obtained was mixed with alcohol. It appeared, however, that this alcoholic solution of the acetate exerted no solvent action upon sulphate of lead, for a permanent precipitate of the latter was produced in the mixture of acetate of ammonium and normal sulphuric acid by the first drop of the standard solution of acetate of lead. The same negative result was obtained in several repetitions of the experiment, even when new portions of dilute alcohol and a second set of the standard solutions were employed.

When, however, the solution of acetate of ammonium was mixed with an equal bulk (10 c.c.) of the standard solution of sulphate of ammonium, instead of the sulphuric acid, a considerable quantity of sulphate of lead was held in solution by it. In two distinct trials, the precipitate formed by dropping acetate of lead into the mixed solution of acetate and sulphate of ammonium continued to redissolve until 3 c.c. of the standard solution of acetate of lead had been added to the liquor. These 3 c.c. of the standard solution contained 0·1137 grm. of acetate of lead, corresponding to 0·0909 grm. of sulphate of lead. To hold dissolved 1 part of sulphate of lead in the dilute alcohol charged with sulphate of ammonium, there was consequently required 110 c.c. of a tolerably strong solution of acetate of ammonium.

Still another experiment with sulphuric acid was made, by mixing 10 c.c. of an entirely new preparation of acetate of ammonium with a similar quantity of the standard solution of acetate of lead, and dropping the standard sulphuric acid into the mixture. No persistent precipitate was produced in this case until 5 c.c. of the acid had been added. This quantity of the standard acid contained 0·049 grm. of sulphuric acid, corresponding to 0·1515 grm. of sulphate of lead; hence only 33 parts of the solution of acetate of ammonium were required to dissolve 1 part of sulphate of lead. It is to be observed that the insolubility of tartrate, citrate, and succinate of lead in alcohol prevents the application of this modified form of the experiment in the examples given below. With the exception of the acetates of ammonium and sodium, none of the salts experimented with can be mixed with the acetate of lead and subsequently tested with sulphuric acid or sulphate of ammonium.

Acetate of Sodium, whether mixed with the normal sulphuric acid, with sulphate of ammonium, or with acetate of lead, seemed to have no solvent action upon sulphate of lead.

Neither *Oxalate of Ammonium* nor normal *Oxalate of Potassium* exerted any solvent action, either in presence of the sulphuric acid or the sulphate of ammonium.

Tartrate of Ammonium.—Normal, crystallised tartrate of ammonium was dissolved in alcohol of 18 per cent, in such proportions that 500 c.c. of the solution contained 1-10th of an equivalent, 18·4 grms. of the salt. Twenty-five c.c. of the solution were mixed with an equal volume of the normal sulphuric acid; and normal acetate of lead was added to the mixture until a permanent precipitate was produced. To effect this result, there was required of the standard solution of acetate of lead 2 c.c., or 0·0758 grm. of the acetate, corresponding to 0·0606 grm. of sulphate of lead. The 25 c.c. of the solution of tartrate of ammonium contained 0·92 grm. of the dry salt. Hence, something more than 15 parts of tartrate of ammonium are required to hold 1 part of sulphate of lead dissolved in diluted alcohol containing free sulphuric acid.

In two other experiments, where the tartrate of ammonium solution was mixed with the sulphate of ammonium, instead of with free sulphuric acid, 3 c.c. of the acetate of lead solution had to be added before a permanent precipitate could be formed.

That sulphuric acid is a more efficient precipitant of lead in presence of tartaric acid than sulphate of ammonium was shown in another way. Thirty c.c. of the standard alcoholic acetate of lead were mixed with an equal volume of the standard solution of tartrate of ammonium. The precipitated tartrate of lead was filtered, and the filtrate mixed with a quantity of the sulphate of ammonium solution. No precipitate was produced, though, on the subsequent addition of sulphuretted hydrogen, a slight precipitate of sulphide of lead was formed. In a similar experiment, where sulphuric acid was substituted for sulphate of ammonium, a slight precipitate was produced by the sulphuric acid, and no precipitate could be obtained afterwards with sulphuretted hydrogen.

In two other experiments, where 5 c.c. of the acetate of lead solution were mixed with 30 c.c. of the tartrate of ammonium, no precipitate was produced by sulphate of ammonium in the filtrate from the tartrate of lead, while sulphuric acid gave a slight precipitate as before. In this case, however, sulphuretted hydrogen gave a slight precipitate after sulphuric acid as well as after sulphate of ammonium.

Normal *Tartrate of Potassium*, mixed with the solution of sulphuric acid, exerted no solvent action on sulphate of lead.

Succinate of Ammonium, prepared by neutralising a solution of succinic acid with ammonia-water, exerted no solvent action when mixed with the free sulphuric acid; but, when mixed with the solution of sulphate of ammonium, 6 c.c. of the acetate of lead solution were added to the liquor before a permanent precipitate fell.

Normal *Citrate of Ammonium* was prepared by neutralising a weighed equivalent portion of crystallised citric acid with ammonia-water. Ten c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the standard solution of acetate of lead was dropped into the mixture in the usual way. No permanent precipitate was formed until 16 c.c. of the lead solution had been added. These 16 c.c. contained 0·6064 grm. of acetate of lead, corresponding to 0·4848 grm. of sulphate of lead. The 10 c.c. of citrate of ammonium solution contained 0·42 grm. of crystallised citric acid. Hence, 1 part of sulphate of lead was held dissolved in the mixture of alcohol and dilute sulphuric acid for every 0·8663 part of citric acid in the liquor.

On repeating the experiment, a precisely similar result was obtained: 16 c.c. of the standard lead solution had to be added to the mixture of alcohol and sulphuric acid before the precipitate ceased to re-dissolve as fast as it formed.

In two other experiments, where, instead of free sulphuric acid, 10 c.c. of the standard solution of sulphate of ammonium were mixed with 10 c.c. of the citrate of ammonium solution, 30 c.c. of the standard lead solution had to be added in each case before any permanent precipitate formed.

Dicitrate of Ammonium, $C_{12}H_6(NH_4)_2O_{14}$, was prepared in crystals, and 22·6 grms. of the salt were dissolved in 500 c.c. of the 18 per cent alcohol. Twenty-five c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the acetate of lead solution was dropped into the mixture in the usual way. After the addition of 8 c.c. of the standard acetate of lead, a permanent precipitate was produced. These 8 c.c. contained 0·3032 grm. of acetate of lead, corresponding to 0·2424 grm. of sulphate of lead. The 25 c.c. of dicitrate of ammonium solution contained 1·13 grms. of the dry salt. Hence, 1 part of sulphate lead was held dissolved for every 4·6617 parts of the dicitrate.

Tricitrate of Potassium.—Twenty-five c.c. of a standard solution of ordinary crystallised citrate of potassium, mixed with an equal volume of the standard sulphuric acid, gave no permanent precipitate until 2 c.c. of the solution of acetate of lead had been added to it.

Sugar.—A standard solution of cane-sugar, mixed with an equal volume of the sulphuric acid, gave a permanent precipitate on the addition of the first drop of the acetate of lead.

These experiments show clearly that very considerable quantities of sulphate of lead can be held in solution by weak alcohol charged with various salts. It may, therefore, reasonably be inferred that wines sometimes retain lead in solution, in consequence of this action of the acids and salts peculiar to wine upon lead compounds ignorantly employed to correct acidity.

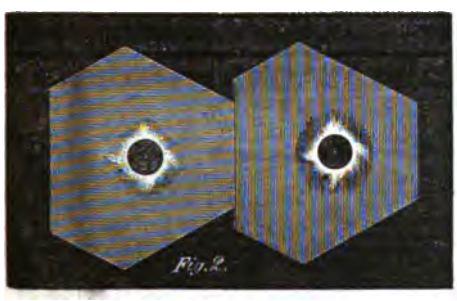
NOTE ON THE SUPPOSED POLARISATION OF THE CORONA.*

By Prof. E. C. PICKERING.

An observation on this subject is given in my report in the CHEMICAL NEWS (vol. xx., p. 222), but as the form of the instrument used has been in one or two cases misunderstood, I enclose a sketch of it. A, B (Fig. 1) is a sheet-

iron tube, closed at A with a plate of quartz, and at B with a prism of Rochon, The latter has the property of giving two images of any object seen through it, separated by an angle of nearly 3°. Looking through the tube we therefore see two images of the quartz touching, but not overlapping. When the light is polarised, these images assume complementary tints, which vary with the plane of polarisation and the thickness of the quartz. On turning this instrument towards the sun during totality, the images presented the appearance shown in Fig. 2.

The hexagons represent in form and size the plate of quartz; the black circles the moon, here drawn a sixth of



an inch in diameter, as the scale is about 3° to the inch. The corona appeared white, but the sky surrounding it was coloured in one image blue, in the other, yellow,—represented in the figure by vertical and horizontal lines. The conclusion to be drawn from this is, that the light of the corona is unpolarised, or, more strictly, that the amount of polarised light, if any, is too slight to be perceptible with this instrument. Its delicacy, although not equal to Savart's polariscope, is very great, giving coloured images with paper, wood, and other bodies which reflect a small amount of light specularly. The day before the eclipse it showed, in a very marked manner, the polarisation of the wet pavements and roofs. To measure its sensitiveness, I viewed the light reflected by a piece of plate glass, at different angles of incidence, and found that the colour ceased to be visible when this angle was about 10°, which, allowing for the reflection from the second face would give about one part of polarised to twenty-four of natural light.

Observers heretofore have generally attached their polariscope to a telescope, and thus introduced a source of error, avoided in my instrument. For light passing through the object-glass and field lens would be polarised before reaching the polariscope by the obliquity of the incidence, caused both by the curvature of the surfaces and the fact that the edge of the field of view receives its light not parallel to the axis. The plane of polarisation would be perpendicular to a plane falling through the axis of the instrument. Now, if any part of the corona was brought into the centre of the field of view, the adjoining portions would appear polarised in planes parallel to the edge of the field, or passing through the sun's centre. In sweeping around the sun's edge, the plane of polarisation would continually change, as the corona passed through different parts of the field, and the comparative darkness of the moon's disk and the exterior sky prevent the polarisation of the other portions of the field from being visible. The degree of polarisation by refraction would be very slight and perhaps imperceptible, but the agreement of observation with this hypothesis is certainly a curious coincidence.

The strongest argument against the polarisation of the corona is furnished by the spectroscope, the presence of bright lines and absence of dark ones, as observed by Prof. Young, denoting incandescence, a view strengthened by the consideration that each square centimetre of the surface of the corona would receive several thousand units of heat per minute. I am well aware that my results are at variance with those obtained by previous observers, including some of the most eminent astronomers of the day, but as far as I can learn this form of polariscope has not been used for the purpose, and therefore hope that my experiment may be repeated during the next eclipse.

* Communicated by Prof. Morton, Editor of the *Journal of the Franklin Institute*, to whom we are indebted for copies of the woodcuts.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 9).

THE processes of recording microscopical observations are scarcely less important than those employed in making them. The facts accumulated by the most painstaking observers are of comparatively little use unless means are found of preserving and communicating them to others. This is particularly the case with regard to microscopical studies, and, like most natural-history observations, written descriptions, however graphic, are scarcely intelligible unless accompanied by truthful drawings. The concluding portion of these papers could, therefore, hardly be considered as complete without some mention of the way of writing this language of all nations, a subject which has, with a few exceptions, met with but little attention from writers on the microscope: probably being very expert themselves, the idea prevailed that drawing was as natural an acquirement as writing, and that no special directions were needed. The lectures which supplied the matter for these pages being intended for persons wholly unacquainted with the use of the microscope, it was then deemed advisable to treat upon the subject of microscopical drawing and micrometry at greater length than usual, dwelling especially on those points upon which little information is to be found in books; and the author has seen no reason to alter his opinion

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

since the delivery of the lectures, but has rather added than withdrawn matter.

Photography, from its extreme accuracy and delicate rendering of details, claims a very high place among the resources of microscopical art. When the object is suitable for its employment, the result is not to be equalled by any other means of delineation. The conditions, however, which it is requisite to comply with in order to obtain a successful micro-photograph somewhat limit the cases in which it is available. The object to be photographed should be very thin and flat, so that the whole, or the greater part of it, lies in the same plane, that it may all be in focus at once; the reduction of aperture commonly used by landscape photographers to secure focal depth not being practicable, on account of the great loss of light occasioned by the use of small diaphragms, which is so great when the object is much magnified as to render the production of an impression on the prepared plate impossible with any reasonable amount of exposure. This is a very great drawback, as many of the most interesting microscopical objects can scarcely be seen without continual alteration of the focal adjustments. The colour of the object should also be such as is favourable for photographic purposes; the yellow, brown, and red tints of many tissues render it impossible to obtain any satisfactory result. The best photographs are always those obtained from colourless objects, such as the *Diatomaceæ*, the delicate sculpture on the frustules of which are marvellously rendered, as may be seen by examining the photographs by Dr. Maddox, to be procured of Mr. How, of Foster Lane, at a merely nominal price. So minutely are the details produced that they will, when photographed upon glass, bear a considerable amount of enlargement by means of the magic-lantern.

At present only objects illuminated by transmitted light have yielded impressions on the prepared plate, the more feeble images obtained from reflected light and dark field illumination have failed in producing photographs, and so a large and interesting class of objects is excluded. Possibly future improvements may remove this, and some other difficulties which at present limit the use of this valuable art. The necessity of employing special apparatus and of mastering a delicate set of chemical processes will, it is to be feared, prevent many microscopists from availing themselves of photography as a means of delineating the objects presented to them in the course of their studies.

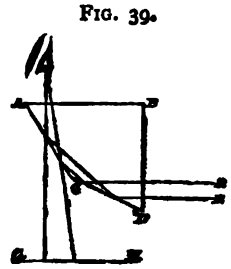
The practical details of manipulation and the bibliography of the subject are treated at considerable length in Dr. Beale's "How to Work with the Microscope," 4th edition, pp. 229 to 279.

Fortunately, the other processes used in making representations of objects are within reach of the majority of microscopists. The apparatus being simple and inexpensive, compared with that needed for obtaining photographs, and the use of it so easily mastered, that, with a little perseverance, most persons will be found able to obtain drawings really useful, although, perhaps, somewhat wanting in finish and delicacy. Even these may be attained in some degree by painstaking application; and, although the student's productions may not equal the work of professional artists, they will be found to possess an amount of truth which would most likely be wanting in the work of a more accomplished but less scientific draughtsman.

The simplest, but not the easiest, method is to make the drawing without instrumental aid. Few but those who are expert draughtsmen can accomplish this. The difficulty of obtaining anything approaching an accurate representation can only be understood by those who are familiar with the process. The chief obstacle is the impossibility of seeing object and drawing nearly together, as in landscape or other sketching, and the consequent trouble occasioned by frequently losing the place, especially during the earlier stages of the outline; the peculiar view afforded of the object depriving the observer of those guides used in ordinary drawing from nature. The impossibility of making the drawing to scale is another disadvantage, and renders it of but little value as a microscopical record. For objects in active motion no other mode is available, and in such cases it is of value, also, for making slight sketches and memoranda during observations, and preserving facts which would otherwise be lost; but where considerable accuracy is needed some one or other of the instrumental appliances now to be described must be employed. Nearly all the instruments attached to the microscope with a view to aid delineation act upon the principle of rendering the image of the object and the paper and pencil-point visible together and apparently blended. This may be accomplished in several ways, although the principle of reflection is used in all cases.

The oldest of these instruments is the *camera lucida* of Dr. Wollaston; it consists of a four-sided glass prism (Fig. 39), of which the angle A, B, D

Fig. 39.



equals 90°, the angles B, A, C, and B, D, C, 67° 30', and the angle A, C, D, 135°; it acts by twice reflecting the rays R and R', proceeding from the eye-glass of the microscope, which enter through the side B, D, first at C, D, and afterwards at A, C, to the eye, so placed at A that one-half of the pupil is over the edge of the prism, and views the image of the object in the microscope, the pencil and paper being seen by the other half, which is placed beyond the edge A. As the reflections are internal,* there is scarcely any loss of light; the image is consequently very bright, and owing to its being twice reflected, it is not inverted when it reaches the eye. The prism is mounted in a convenient setting, so that it may be fitted over the eye-piece in the place of the cap, which is of course removed. A lens is sometimes attached to the lower part of the camera lucida, between the eye and the paper; this is of use to persons who cannot see the drawing distinctly at the usual distance, about ten inches, and may be either convex or concave, according to the special requirement of using it.

* Chemical News, vol. xx., p. 266.

A small steel disc, known as *Soemmering's mirror*, placed at an angle of 45°, is used by some microscopists. The polished disc is smaller than the pupil of the eye; so that, while the image from the microscope is viewed by the centre of the pupil, its circumference is employed in viewing the paper and pencil-point, upon which the image appears to be projected, as in the camera lucida.

(To be continued.)

ON ESSENCE OF SASSAFRAS.

By MM. E. GRIMAUX and Y. RUOTHE.

ESSENCE of *Laurus sassafras* is colourless when first rectified, but turns gradually yellow after exposure to air and light. Its smell resembles that of essence of fennel. Its density at zero is 1·0815; it rotates the polarised ray to the right, and its rotatory power is 3·5° for a length of 10 centimetres. It is a mixture of dextrogyrous hydrocarbon with an inactive oxygenated principle, and also contains small quantities of a body which is apparently a phenol, and which gives it the power of reducing nitrate of silver. This body is separated from the essence by stirring with this latter an aqueous solution of potash, which, after the addition of chlorhydric acid, precipitates some oily drops, having a strong smell of eugenic acid, and coloured light green by ferric chloride. By distilling this body with steam, a colourless liquid was obtained in just sufficient quantity to permit analysis, which gave C=74·43, H=6·46. Such extremely small proportions are found in the essence that it can scarcely be said to do more than exist. The hydrocarbide (safrène) contains $C_{10}H_{16}$, which formula is confirmed by the density of its vapour, which, ascertained by Dumas's method, was found equal to 4·71 (theoretically, 4·7). Safrène boils between 155° and 157°, is dextrogyrous, and its rotatory power is 17°·5 for a length of 10 c.c.; its density at zero is 0·8345.

Nine-tenths of the essence are extracted after the first distillation between 230° and 236°. They consist of an oxygenated principle (safrol), which distils chiefly between 231° and 233°. This latter has not a constant boiling point, for it always changes and becomes slightly resinous under the influence of much heat. It is insoluble in water, but difficult to dry over chloride of calcium, and requires rectification in a current of pure hydrogen before analysis. Its odour is similar to that of the essence; its density 1·1141 at zero; it exerts no influence on polarised light, and remains liquid at a cold as low as −20°. Safrol will not combine with bisulphites, dissolve sodium, or decompose chloride of benzoyle at its boiling point. It will not dissolve alcoholic potash even at 180°, but is changed by it into a black, non-crystallisable resin.

Treated with boiling iodhydric acid at 127°, it yields a thick green iodised oil; with perchloride of phosphorus it gives only a protochloride, and no trace of oxychloride, and the thick viscous body left in the retort after distilling the protochloride should be a monochloruretted safrol. It does, in fact, present the appearance and qualities of those monobromised derivatives obtained by merely adding a molecule of bromine to a molecule of safrol, but if excess of bromine be added, a solid crystallised derivative of pentabromised safrol, $C_{10}H_5Br_5O_2$, is obtained. To prepare this body, dissolve safrol in sulphide of carbon, and add five times its weight of bromine; after a few days the vessel will be found to contain crystals. Dissolve these in chloroform, wash the solution with potash, and concentrate; rectangular and perfectly white flakes of pentabromised safrol, $C_{10}H_5Br_5O_2$, will separate.

This body melts at 169° or 170°, is but slightly soluble in alcohol or ether, even at the boiling point, and dissolves in about fifteen times its weight of chloroform, with simultaneous production of a very small quantity of another bromised derivative melting at 109°. Upon subjecting safrol to the action of sundry other reagents, no satisfactory results were obtained. Nitric acid, even when much diluted, renders it resinous, with production of oxalic acid; it dissolves in the fuming acid, yielding a non-crystallisable derivative, soluble in alkalies at moderate temperature. When heated with chloride of zinc or phosphoric anhydride, it quickly decomposes, leaving much carbon; sulphuric acid produces the same effect. Fusing potash attacks it with difficulty; a distillation of the essence over melting potash modifies its boiling point; that which formerly distilled between 230° or 234°, now comes over between 245° and 250°, and even at from 247° to 248°. The analysis of this body gives the same figures as that of the essence.

CORRESPONDENCE.

GMELIN'S CHEMISTRY.

To the Editor of the Chemical News.

SIR.—It is known, no doubt, to all your readers that the Cavendish Society has been for some years defunct, and that their works are understood to have been handed over to their publisher, Mr. Harrison, of 59, Pall Mall. That gentleman has since issued the two last but one volumes of the translation of "Gmelin's System of Chemistry," which, at the demise of the Society, was incomplete. But the last volume (vol. xviii.), which is to contain the index, is not yet published, nor does there appear any certainty when it will be, if ever.

Yet, in the absence of this index volume, this magnificent work is almost useless to chemists for reference. Two or three years having elapsed without any progress towards our attaining this index being apparent, may I enquire whether Messrs. Harrison have any copyright in this work, and if not, suggest that it would, probably, be worth the while of some other publisher to set vigorously about producing the index to Gmelin.—I am, &c.,

REFERENCE.

January 11, 1870.

SAMPLING OF CARGOES OF PHOSPHATIC RAW MATERIALS.

To the Editor of the Chemical News.

SIR,—It has now become a settled practice to fix the price to be paid per ton according to the percentage of tribasic phosphate of lime found by analysis. Samples are usually sent to two chemists, and, for their convenience, sent in fine powder. The seller or his agent suggests that, to procure this powder, the material should be passed through mill-stones; and some manufacturers are unwise enough to consent to such a vicious practice, which goes far to explain the well-known fact that, given a certain quantity of material stated to contain a certain percentage of phosphate of lime, you can never obtain, in the manufactured article, the amount of phosphate you had right to expect by calculation. In the action produced by the process of grinding, great heat is evolved, which heat proceeds from the moisture which is thus, to a certain extent, used up, and disappears; and thus it is not unfrequently found that 1, 2, or 3 per cent of moisture disappears, and the phosphates, consequently, are increased in the analysis. We have long expected that analytical chemists, who must have been well aware of the injustice, would have come forward and proposed a remedy; but they have not done so; and, lest it may be supposed that it is a necessary evil, and there is no cure, we beg to suggest one or two modes by which the injustice can be removed.

1. While the cargo is being discharged, let one weighing in fifty be placed over a kiln or some convenient drying-place, and thus a great portion of the moisture dried off and ascertained. Most manufactories afford convenient means for accomplishing this, which can be done by the sellers and buyers' agents, and during the discharge of the cargo. Suppose 5 per cent of moisture is thus driven off, then the phosphate found in 95 grs. of such sample will represent that which exists in 100 grs. of the cargo. There will then be no objection to passing the dried sample through stones. This mode is particularly suitable for wet cargoes; but, in a case where this drying cannot be conveniently accomplished,

No. 2 plan may be adopted, which is either to send rough samples to the chemist or, if, for their convenience, a fine sample is wanted, to send a rough sample with it at the same time, from which the chemist should ascertain the moisture. In all cases, as the moisture resides mostly in the fine part of the cargo, it is desirable to pass the sample lot through a screen, and then, by weighing each separately, to ascertain their respective proportions, and then taking care that the sample for analysis should be made up in the same proportion—say one of fine, and and two of rough, as the case may be.

3. There is yet another mode of dealing with the difficulty, and that is for the seller to allow the buyer 1 or 2 per cent, according to the dampness of the cargo, for the privilege and convenience of allowing the whole to be ground under stones.

Here, then, are three methods, each fair to both parties, and vastly preferable, we think, to the unjust system frequently pursued and which often leads to disputes.—We are, &c.,

SPOONER & BAILEY.

MISCELLANEOUS.

New Food Journal.—We perceive with pleasure that Messrs. J. M. Johnson and Sons, of Castle Street, Holborn, announce their intention of bringing out a new and cheap periodical, called the *Food Journal*, to be devoted entirely to the very important subjects of Food and Public Health. These two great questions are so prominent now-a-days, and embrace so many details of personal interest, that we cannot, even on purely selfish grounds, refuse to listen to them, especially when put before us in any other but a professional and technical guise. The adulteration question will be largely and carefully dealt with, and many of the leading sanitary writers of the day will contribute to the pages of the Journal.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, December 27, 1869.

This number opens with an eulogium on—

The Annuaire du Bureau des Longitudes for 1870.—M. H. St. Claire-Deville.—The speaker observes that this very useful periodical has, in consequence of its various and comprehensive scientific data and memoranda, become indispensable to the scientific chemist; and the well-known *savant* desires to see its use greatly extended. As is known (at least, to some of our readers), the periodical alluded to owes its origin to the eminent men who were foremost among the authors of the first French Republic, and who founded the Ecole Polytechnique.

Acclimatisation of the Cinchona Trees in the Island of Réunion.—M. Morin.—The author, encouraged by the success obtained in the British and Netherlands' Colonies, has induced a friend residing in the above-named island, a French possession, to try the acclimatisation of this important tree; and the result is such as to foster the reasonable expectation that the Island of Réunion will, within a few years, also become a *Cortex*-producing country.

Presence of Soda and Potassa in Divers Parts of Plants.—M. Pierre.—In reply to some objections made by M. Peligot to the author's statements on this subject, he says—I admit the presence of a small quantity of soda as a normal constituent of plants, but its quantity decreases permanently, whereas the quantity of potassa increases constantly during the life of plants. The increase of the latter base follows the same rule as the increase of phosphorus, nitrogen, &c.; and while potassa is combined in a manner which renders it a very fixed mineral, soda is easily removed by a simple treatment with distilled water.

Artificial Production of some Precious Stones.—M. Gaudin.—While presenting to the Museum of the Academy an exquisite collection of artificially-prepared precious stones, the author communicates some curious observations on the effect of a powerful oxyhydrogen blowpipe blast. Alumina, by itself, cannot serve for obtaining precious stones, owing to the tendency of this earth to devitrify again. It does not become pasty before fusing, but liquefies at once, and is as fluid as water; and next volatilises as if it were camphor. In order to render alumina viscous, quartz has to be added; but that impairs the crystallisation, and also the hardness. The colouration of the stones is another difficulty, since the enormously high temperature of the oxyhydrogen blast acts upon several substances, such as compounds of gold, silver, palladium, and other metals, in a manner quite different from that of a furnace fire. Copper is a protean substance in this aspect, and, by dexterous manipulations, may be used to produce many tints of colour. Curiously enough, manganese and nickel yield, at this high temperature, an orange-yellow colouration; and chromium, exposed to the reducing flame, gives a sky-blue, and in the oxidising flame, a deep green, which is smoked (*enfumé*), as it were, and has not even a remote resemblance to emerald green. This colour can only be obtained by a special and very well directed oxidising manipulation from oxide of copper.

Rendering Commercial Sulphide of Carbon Inodorous.—M. Cloëz.—The author states that, when sulphide of carbon is left for twenty-four hours in contact with half per cent of its weight of finely-powdered corrosive sublimate, care being taken to shake or stir up this mixture, the mercurial compound combines with the substances which are the cause of the fœtid odour of this substance, and an insoluble compound is deposited. The liquid is carefully decanted, and, after 0·02 of its weight of a pure inodorous fat has been added (no reason is given for this addition), the sulphide is re-distilled with care by the heat of a water-bath. The sulphide thus obtained exhibits an ethereal odour, and is eminently suitable for the extraction of oils, fats, &c., from various substances, since, on evaporation of the purified sulphide, these matters are obtained in as fresh and pure a state as if the oils had been obtained by pressure.

Chemistry of Copper.—Dr. Sterry Hunt.—The author has instituted a comparative research on protochloride of copper, Cu_2Cl, and chloride of silver. The properties of these salts agree in so many aspects, according to the author, that he feels inclined to place these metals, copper and silver, in the same class.

General Researches on the Modifications which Minerals Undergo when Submitted to the Action of Saline Solutions.—M. Terreil.—The author describes, at great length, in this paper, the action of a solution of monosulphide of sodium (1 part of dry salt in 10 of water) upon a great number of metallic sulphides, selenides, tellurides, and antimoniosulphides; the conclusion arrived at is that monosulphide of sodium may advantageously be applied, not only for the separation, but even the quantitative determination of some metals existing in minerals in the state of sulphides.

Preparation and Properties of Hydrate of Chloral.—M. Personne.—Referring to the labours of MM. Roussin and Dumas on this subject, the author, after repeating, with great care, the experiments of the last-named eminent *savant*, concludes that the substance obtained by M. Roussin (a sample of which, given by the latter to the author, had been analysed by him) is not pure hydrate of chloral, but a trichlorinated acetate, of the formula $C_4HCl_3,C_4H_2O_3$. The author also observes that, whereas 100 parts of absolute alcohol yielded, by M. Roussin's mode of preparation, only 80 per cent of substance, he, on following exactly M. Dumas's method, obtained 185 per cent of a real and pure hydrate of chloral.

Separation of Ordinary from Inverted Sugar.—M. Dubrunfaut.—The author, continuing his altercations and discussions with M. Maumené on this matter, describes in this paper, at great length, his experiments of separating, by means of lime, ordinary sugar from inverted sugar.

Simultaneous Action of the Intra-Pilair Current and Nascent Hydrogen upon Organic Acids.—M. Royer.—Under the influence of nascent hydrogen and *intra-pilair* action, the author has converted oxalic acid into formic acid.

Metamorphosis and Migrations of the Immediate Principles in Herbaceous Plants.—M. Dehérain.—This lengthy memoir contains the records of an interesting series of researches proving the curious changes which substances—as, for instance, sugar, albumen, gum, &c.—undergo in the living plants, and especially in the cereals

Detection of Cyanhydric Acid and Cyanides in Cases of Poisoning.—M. Bonjean.—A foot-note added to this title of a paper, and signed "D.," informs the reader that this paper could not be printed for want of sufficient experimental details.

Heavy Flint-Glass for Optical Purposes.—M. Feil.—This gentleman sends in samples of perfectly homogeneous glass free from

any bubbles or defects, and in masses weigl ing from 25 to 35 kilos. The process whereby this is obtained is not explained; but the statement is made that the crucibles having been protected from the effects of the lead, a heavier glass even than Faraday's can be made. The maker sends, also, a set of samples of beautifully-made artificial precious stones, not mere specks, but of good size. The mode of manufacture applied to these gems will, according to the author's statement, give interesting results for the study of some optical phenomena. The aluminates of lime, of baryta and lime, of lead and of bismuth, are proposed for flint-glass; and the aluminates of magnesia and the silicates of magnesia and alumina for crown-glass.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18, 1869.

At the ordinary meeting of this Society, held on the 22nd of November last, under the presidency of Dr. A. W. Hofmann, the following papers were read:—

Lecture Experiment to Show the Increase of Weight Caused by Combustion.—Dr. Kolbe.—Since the value of this paper rests entirely upon the woodcut annexed to it, describing the very ingenious apparatus contrived by the author, we only mention the title.

Carbonate of Phenol.—M. Kempf.—When three parts of phenol and two of fluid phosgen are heated to about 150°, and the contents of the tube afterwards treated with a dilute solution of caustic soda, a solid substance is obtained which crystallises from its alcoholic solution in white silky-looking needle-shaped crystals. The formula of this substance is $C_{13}H_{10}O_3$; it is insoluble in water, readily soluble in alcohol and ether, fuses at 78°, and can be sublimed. When treated with concentrated caustic soda solution, it yields carbonate of soda and phenyloxyd-soda; its formula, as carbonate of phenol, is $(C_6H_5)_2O_2(CO)$.

Action of Chloro-Chromic Acid (Chromsäure-chlorid) upon the Aromatic Hydrocarbons.—M. Carstenjen.—Chloro-chromic acid, CrO_2Cl_2, acts, when pure, with so great violence upon most organic substances, that deflagration ensues. The author has found that glacial acetic acid is the best diluent, and with such a solution he has investigated its action upon the following substances:—*Benzol.** *Naphthalin* yields a compound, $C_{10}H_4Cl_2O_2$, fusing at 188°, and soluble only in boiling alcohol; it is a bichloronaphthochinon, and is derived from naphthalin according to the following formula:—

$$4CrO_2Cl_2+C_{10}H_8=C_{10}H_4Cl_2O_2+2Cr_2O_3+4HCl+2Cl.$$

Anthracen yields bichloronaphtochinon and anthrachinon, free from chlorine; formula, $C_{14}H_8O_2$. *Toluol* yields benzoic acid and rather complex results, which are formulated thus:—

$$C_6H_5.CH_3+2CrO_2Cl_2=C_6H_5.COCl+3HCl+Cr_2O_3.$$

The $C_6H_5.COCl$ acts further upon the glacial acetic acid, in the following manner:—

$$C_6H_5.COCl+CH_3.COOH=\left\{\begin{matrix}C_6H_5.CO\\CH_3.CO\end{matrix}\right\}O+HCl,$$

and the mixture of *ankydrous acids* yields, with H_2O, benzoic acid and acetic acid. With xylol, the final result of the reaction is an acid—a solid substance fusing at 173°, and of the composition of toluylic acid—and besides, also, terephthalic acid. Pure mesitylen prepared from aceton is almost insoluble in glacial acetic acid; the action of chloro-chromic acid is consequently very violent, and great caution is required in managing this experiment. The result is the formation of mesitylenic acid.

Contribution to the History of the Sulphocyanides of the Alcohol Radicals.—M. Henry.—This paper is divided into the following sections:—Action of iodide of cyanogen upon mercuro-mercaptan, $(C_6H_5)_2HgS_2$; trisulphocyanallyl, $C_3H_5(CNS)_3$; sulpho-cyanide of benzyl, or methyl-benzol, $C_6H_5-CH_2CNS$; nitro-sulphocyanide of benzyl, $C_7H_6(NO_2)CNS$.

Direct Combination of Chloride of Phosphorus (PCl_3) with Sulphur.—M. Henry.—The author says—Dr. Odling states, in his excellent "Manual of Chemistry" (vol. i., p. 287), that oxygen and chloride of phosphorus combine directly at the boiling-point of the chloride. Acting upon this hint, the author tried whether sulphur would act in the same manner, and yield $PSCl_3$. Very pure chloride of phosphorus, boiling at 78°, was heated to 130°, along with pulverised sulphur, in a sealed tube; the sulphur disappeared. On being submitted to distillation, the fluid came all over at 120°, and the distillate, a colourless fluid exhibiting a sharp smell, proved to be the compound $PSCl_3$.

Wax of Corn-Straw.—M. Radziszewski.—After referring to the researches on the subject of the wax of the *Gramineæ*, made by Dr. G. J. Mulder, M. Dumas, and others, the author states that he has found a waxy substance in the straw of the corn species. This substance is insoluble in water and solutions of caustic alkalies; soluble in boiling alcohol, ether, and sulphide of carbon; fuses at 42°; boils, without decomposition, at 300°; and sublimes at 303. This substance has, therefore, some analogy with the *cérosie* from sugar-cane. The author states that the sample investigated by him was given him by M. Naeyer, paper manufacturer, at Willebroeck lez Malines, Belgium, who appears to have first obtained this material while converting straw into pulp.

On Mercurodiphenyl.—M. Otto.—The author refers back to a paper on this subject by him and M. Dreher (see CHEMICAL NEWS, vol. xx., p. 285), and explains, in this present paper, his views, dissenting from some statements made by his co-partner. The paper is not suited for abstraction.

Hydrate of Bromal, and its Action upon the Animal Organism.—M. Steinauer.—The author prepares the hydrate of bromal by causing a current of carbonic acid, saturated with vapours of bromine, to pass into alcohol. The hydrate of bromal thus obtained in large crystals was purified by re-crystallisation, and then used for experimenting with upon animals.

Action of Iodide on Thiobenzamide.—Dr. Hofmann.—When, to a cold saturated alcoholic solution of this benzamide—

$$\left.\begin{matrix}C_7H_5S\\H\\H\end{matrix}\right\}N,$$

an alcoholic solution of iodine is added, the latter soon becomes decoloured, and sulphur is precipitated; when iodine is added in slight excess, the liquid, after having been decanted from the free sulphur it contains suspended, becomes a thick magma on the addition of water. By washing with the latter, the hydriodic acid is removed; and by resolution and repeated re-crystallisation from boiling alcohol, a solid snow-white substance is obtained, fusing at 90°, and subliming without decomposition, at a high temperature; this substance is also soluble in ether, chloroform, and benzol, and the author considered he had to deal with a compound freed from sulphur, since even delicate tests failed to indicate its presence. When, however, the vapour of this substance is passed over a red-hot mixture of pure nitrate of potassa and carbonate of soda the presence of sulphur is ascertained without difficulty. Elementary organic analysis of this substance led to the formula $C_{14}H_{10}N_2S$, and its formation is expressed by the following equation:—

$$2C_7H_7NS+2II=C_{14}H_{10}N_2S+4HI+S.$$

Chlorine, bromine, and moderately-dilute nitric acid act in the same manner upon thiobenzamide. The author states that the new compound just alluded to exhibits a most remarkable stability, and a stolid insensibility against the action of even rather strong reagents and rough treatment. Acids, even at boiling-point and in sealed tubes, do not affect this material, and the action of alkalies is very gradual and slow; by hydrogen, *in statu nascendi*, it is converted into a base, the hydrochlorate of which is formulated by $C_{14}H_{14}N_2.HCl$; and the composition of the platinum salt is $2(C_{14}H_{14}N_2.HCl)PtCl_4$.

Under the title of "Correspondence," this number contains:—

Review of the Labours of the Chemistry Section of the Late Meeting of German Physicists and Natural Philosophers at Inspriick.—Dr. Gunning read an interesting paper on the use of perchloride of iron for the purification of potable waters.—Prof. Barth spoke on the isomeric modifications of toluolsulpho acid and its decomposition by fusing caustic potassa. The chief point of interest, as regards this matter, is that the author has succeeded in obtaining, from crude toluolsulpho acid, certainly two, and probably three, quite distinct modifications, as exhibited by the difference of the potassa salts of the same.—Prof. Kekulé spoke on the constitution of salts.—Dr. Marquart called attention to the action of perfectly neutral solutions of nitrate of strontia upon wrought-iron vessels used to evaporate that liquid, the consequence of which is the cracking and tearing-up of the metal.—Dr. Batka read a paper on tea, and called attention to the great discrepancies of the analysis of that substance. In the discussion which followed, Prof. Hlasiwetz observed that the quantities of the general principles of plants vary to such an extent, and are so dependent upon the conditions under which plants are grown, that the quantitative estimations thereof are of very little value.

The St. Petersburg correspondent writes—"At the meeting of the Chemical Society held on the 6th of November, O.S. (1869), M. Morkownikoff stated—When any alcohol gives off the elements of water, or when its haloid anhydride gives off a haloid hydrogen, there is simultaneously given off one atom of hydrogen, which is combined with an atom of carbon. By direct addition to unsymmetrically-constituted hydrocarbons, CnH_{2n}, of the elements of H_2O and HX, the latter are so divided that the hydroxyl or haloid combines with that atom of carbon with which the smallest number of hydrogen atoms are combined. According to this view, normal butyl-alcohol ought to yield a butylen, $CH_3-CH_2-CH=CH_2$, and with HI, the iodanhydride of the secondary pseudo-butylalcohol of Luynes; and the isobutylalcohol must yield the tertiary butylalcohol of Butlerow—

$$CH\left\{\begin{matrix}CH_3\\CH_2\\|\\CH_2.OH\end{matrix}\right. \quad \text{should give} \quad C\left\{\begin{matrix}CH_3\\CH_2\\\|\\CH_2\end{matrix}\right. \quad \text{and} \quad Cl\left\{\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right.$$

The experimental researches on this subject, instituted with the isobutylalcohol of fermentation, fully proved the correctness of these views, which are confirmed by M. Butlerow, who has been experimenting in the same direction. M. Gustavson stated that, while heating boracic acid with pentachloride of phosphorus in sealed tubes to 140°, chloride of boron, $BoCl_3$, is readily obtained. Upon causing nitric acid to act upon acetoluide, MM. Beilstein and Kuhlberg have obtained mono- and dinitro-acettoluide. The former yields, with caustic potassa, orthonitrotoluidine; this substance differs from the paranitrotoluidine (as obtained from dinitrotoluol) by its fusing-point, 114°, and by not being capable of combining with acids. M. Wroblewsky has prepared, from chlorotoluol boiling at 156°—160°, a nitrochlorotoluol boiling at between 242° and 255°; by repeated fractional distillation, he obtained two isomeric substances—α, boiling at 243°, sp. gr. 1·307 at 18°; and β, boiling-point 253°, sp. gr. 1·3259 at 18°.—MM. Engelhardt and Latschinow communicated researches made by them on toluolsulpho-potassa and the potassium-salts of xylolsulpho acid.—M. Maikopara communicated his researches on α and β

* The author's paper on this subject, in the *Journal für Praktische Chemie*, No. 14, 1869, having been abstracted by us, we pass this portion over in silence.

naphthalin-sulpho acids and the chloranhydride, amide, and mercaptan of that series.—M. Mendelejeff read a lengthy paper on specific heat, and his researches on this subject.—This ends the correspondence.

Researches on the Ethereal Derivatives of the Polyvalent (Mehrwerthigen) Acids and Alcohols.—M. Henry.—This lengthy paper, a continuation of a former on the same subject, contains the following sections:—Aniso-derivatives; anisaldehyde; aniso-nitril, or methyl-paroxybenzoyl-nitril—

$$C_6H_4{<}^{CH_3O}_{CN}$$

nitro-aniso-nitrile—

$$C_6H_3(NO_2){<}^{CH_3O}_{CN}$$

New Series of Double Chlorides belonging to the Platinum Bases.—M. Thomsen.—This paper is too much filled with formulæ to be fit for any useful abstraction.

Synthesis of Hydroxylamine.—MM. Ludwig and Hein.

Strychnine an Antidote against Poisoning with Chloral.—M. Liebreich.

Critical Remarks upon M. Otto's Paper on Mercurodiphenyl.—M. Dreher.

Zeitschrift für Chemie von Beilstein, No. 23, 1869.

This number contains the following original papers:—

Derivatives of Naphthalin.—MM. Faust and Saame.—The authors have prepared and fully investigated the chlorinated substitution products of naphthalin. They describe A, what they call addition products, viz.:—Naphthalintetrachloride, $C_{10}H_8,Cl_4$, a solid substance fusing at 182°, and crystallising from its chloroformic solution in large rhombohedric crystals; monochloronaphthalintetrachloride, $C_{10}H_7Cl,Cl_4$, also a solid substance crystallising in klinorhombic prisms, and fusing at about 129°; dichloronaphthalintetrachloride, $C_{10}H_6Cl_2,Cl_4$, again a solid substance, crystallising in klinorhombic prisms, and fusing at 172°. All these substances are devoid of smell, difficultly soluble in alcohol, more readily soluble in ether and ligroine; their best solvent is chloroform. B, substitution products:—Monochloronaphthalin, $C_{10}H_7Cl$, a colourless oily fluid, boiling at 250°; monochlorodinitronaphthalin, $C_{10}H_5Cl(NO_2)_2$, a yellow-coloured solid, crystallising in needle-shaped crystals, and fusing at about 104°; α dichloronaphthalin, $C_{10}H_6Cl_2$, a fluid, boiling at about 280°; α tetrachlorotribromodinaphthalin, $C_{20}H_8Cl_4Br_2$, a solid substance, crystallising in white needle-shaped crystals, and fusing at 74°; β dichloronaphthalin, $C_{10}H_6Cl_2$, exhibiting prismatically-shaped crystals, soluble in ether, and fusing at about 282°; β tetrachlorotribromodinaphthalin, $C_{20}H_8Cl_4Br_2$, a solid, fusing at 72°; trichloronaphthalin, $C_{10}H_5Cl_3$; heptachlorodinaphthalin, $C_{20}H_6Cl_7$; heptachlorodinitrodinaphthalin, $C_{20}H_7Cl_7(NO_2)_2$; α tetrachloronaphthalin, $C_{10}H_4Cl_4$; β tetrachloronaphthalin, $C_{10}H_4Cl_4$. All these substances are readily soluble in ether, ligroine, and chloroform, but difficultly so in alcohol; they exhibit the smell of naphthalin. The nitro-products are chiefly yellow-coloured soft substances, difficultly obtainable in pure state.

Some Derivatives of α and β Naphthalin Sulpho-Acids.—M. Maikopar.—The substances submitted to investigation by the author are:—The chloranhydride of the α naphthalin sulpho-acid, α $C_{10}H_7SO_2Cl$, a solid substance, exhibiting foliated crystals; readily soluble in ether, sulphide of carbon, and benzol; fuses at 66°. α amide, α $C_{10}H_7SO_2.NH_2$, also a solid substance, readily soluble in water and alcohol, and fusing at 150°. α mercaptan, α $C_{10}H_9S$, an oily fluid, insoluble in water, but soluble in alcohol and ether; its alcoholic solution yields, with an alcoholic solution of acetate of lead, a yellow-coloured precipitate, a lead compound, $C_{10}H_7PbS$. Chloranhydride of β naphthalin sulpho-acid, β $C_{10}H_7SO_2Cl$, a solid substance, insoluble in water, more difficultly soluble in ether than the α compound, crystallises in foliated crystals, and fuses at 76°. β amide, β$C_{10}H_7SO_2.NH_2$, difficultly soluble in water and ether, and soluble in boiling alcohol. β mercaptan, β $C_{10}H_8S$, insoluble in water, soluble in alcohol and ether, crystalline, and fuses at 136°.

Preparation of Kresotinic Acid from Xylol.—MM. Engelhardt and Latschinoff.—1000 grms. of xylol from coal-tar oil were combined with sulphuric acid; a potassa salt of the sulpho-acid was made, properly purified by re-crystallisation, fused with caustic potassa; the fused mass first treated with water, next with hydrochloric acid, and then treated with ether; the ethereal extract treated with a solution of caustic soda. On evaporating the ether, after decantation, a mixture of xylenols was obtained. The aqueous soda solution yielded, after evaporation and saturation with hydrochloric acid, a substance which on investigation was found to be α kresotinic acid.

Combination of Sulphuric Acid with the Oxides of Nitrogen.—Dr. Winkler.—The author's researches gave the following results:—(1) Hydrated sulphuric acid does not absorb deutoxide of nitrogen. (2) Hydrated sulphuric acid combines readily, and with evolution of much heat, with nitrous acid; this combination is very strong and intimate, is not destroyed by heating, but immediately so by addition of water; the chamber crystals (viz., those sometimes met with in the leaden chambers of sulphuric acid works) consist of this compound. (3) Deutoxide of nitrogen and oxygen do not, when sulphuric acid is simultaneously present, combine to form, as usual, hyponitric acid, but form nitrous acid, even when oxygen is in excess. (4) Hyponitric acid combines, in gaseous, as well as in fluid state, with hydrated sulphuric acid; but this combination, supposing it to deserve that name in a chemical sense, is very loose and unstable; heat destroys this compound, hyponitric acid is given of, either unchanged, or it is converted into nitrous acid, which combines with the sulphuric acid, and free oxygen is given off. The mode of this decomposition depends entirely upon the strength of the sulphuric acid under investigation. (5) Sulphuric and nitric acids only form mechanical mixtures together. (6) Nitrous and sulphurous acids yield, when moisture is present (steam in the chambers), hydrated sulphuric acid and deutoxide of nitrogen, which escapes. (7) Hyponitric acid forms, when in contact with moist sulphurous acid, nitrososulphuric acid, exhibiting solid crystalline structure. These researches have been made with the view of illustrating the action of the Gay-Lussac condensers of sulphuric acid works.

Alleged Presence of Dextrine in the Chesnut.—M. Ludwig.—The author has instituted some experiments in order to test the correctness of M. Albini's statement that the well-known eatable chesnuts (*marrons*) should contain from 22·8 to 23·3 per cent of dextrine. The result of the author's experiments is that this fruit does not contain any dextrine at all, which result agrees with those obtained by several other analysts of this fruit.

New Work on the History of Chemistry.—Dr. A. Ladenburg.—Under the title "Vorträge über die Entwicklungsgeschichte der Chemie inden letzten Hundert Jahren" ("Lectures on the History of the Development of Chemistry during the last Hundred Years"), the author has, according to the editor of this periodical, edited a most excellent complementary volume to Kopp's well-known "Geschichte der Chemie." The work alluded to is in the shape of fourteen lectures on the subject; the arrangement is strictly chronological, and, beginning from Lavoisier, contains a complete, yet concise, record of the history of theoretical chemistry up to the present day. This work is highly eulogised by Dr. Fittig, who wrote a review of it for the above-named periodical.

Les Mondes, December 30, 1869.

Letters on Geology.—M. L'Abbé Choyer.—Although not exactly belonging to the subjects generally treated of in our publication, we call attention to these letters, which are written with great skill, and contain, condensed, a large amount of very useful and interesting information.

Cosmos, January 1, 1870.

Displacement of the Bed of the River Rhine.—M. Bouslot.—The course of the Upper Rhine has very greatly altered, its movement being from west to east (a lateral movement to the course of the downward current) between the Alsatian and Baden banks.

Bread and Railway-Sleepers.—By an order recently issued by M. le Maire de Douai, the bakers of that town have been prohibited from using the wood of old railway sleepers as fuel for their ovens, since many of these sleepers have been impregnated with sulphate of copper, and there is danger that some compound of copper might poison the bread. To the Maire, as head of the local police, is entrusted the proper supervision of everything which may injuriously affect the health of the population.

NOTES AND QUERIES.

Detection of Opium in Tobacco.—Can you kindly inform me how best to detect small quantities of opium when present in tobacco? Neither Fresenius, nor any other work on analysis that I know of, gives any process that I have found available. By doing so, you will greatly oblige.—E. Morton.

MEETINGS FOR THE WEEK.

Monday, 17th.—Medical, 8.
Tuesday, 18th.—Royal Institution, 3. Prof. Humphry, "On the Architecture of the Human Body."
—— Institution of Civil Engineers, 8
Wednesday, 19th.—Society of Arts, 8.
Thursday, 20th.—Royal Institution, 3. Prof. Odling, "On the Chemistry of Vegetable Products."
—— Royal, 8.30
—— Zoological, 4
—— Chemical, 8
—— Royal Society Club, 6.
Friday, 21st.—Royal Institution, 8. Prof. Tyndall, "On Haze and Dust."
Saturday, 22nd.—Royal Institution, 3. Mr. Scott, "On Meteorology."

TO CORRESPONDENTS.

E. K.—We do not intend to publish the lectures spoken of.
F. H. Button.—You had better advertise.
E. Halliwell.—"Laboratory Teaching," by C. L. Bloxam, published by Churchill, will answer your purpose best.

THE CHEMICAL NEWS.

Vol. XXI. No. 530.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 2.)

V. Precautions to be Observed in Estimating the Relative Decolourative Power of Chars.

Simple as the process of testing the relative decolourative power of char samples may appear, very perplexing results are not unfrequently obtained. The object to be aimed at is to make the circumstances which obtain, as nearly as possible, the same on the small scale as on the large, and it is because many little precautionary measures which tend towards the attainment of that equality are usually omitted in the laboratory that such conflicting and apparently inexplicable results are recorded. After many modifications of the process, the author is satisfied, from the results of experiments extending over a considerable period, that if the following points are carefully attended to, the results may be relied upon.

1. It must be decided what the results are to express; whether the relative decolourative power of *equal bulks* or *equal weights* of the chars, *irrespective of size and proportion of grain*, of the chars *uniformly freed from dust*, say by a fifty-mesh sieve, or of *equal weights* of *equal grains*.

2. According as either of these alternatives is decided upon, the various samples must be thoroughly and intimately mixed, and, if necessary, brought to an uniform dryness and temperature. It is always safest to have them thoroughly dry, and at the temperature of the surrounding air.

3. The various samples are next to be filled into glass tubes (tin may be used, but they preclude observations of a very important kind) provided with perforated false bottoms, covered with layers of cloth, and with taps capable of being accurately regulated. The tubes ought to be about 2 inches wide and 2 feet long as nearly of the same diameter as possible. The best method of filling them is by passing the char through a funnel, keeping the spout of the funnel moving constantly in a circular direction, so as to have the large and small grains equally diffused throughout. To allow the char to run down either at one side, or, to a less degree, in the middle, is to cause to a certainty a separation of the larger grains from the smaller, and thus to create channels through which the liquor has too easy access.

4. See that no tube is touched or shaken more than the others, after the char has been filled in.

5. Sufficient brown sugar liquor, of, say, 24° B, must be prepared, either by diluting raw filtered liquor from the sugar-house to that gravity, or by dissolving as much of an average quality of raw material as will make sufficient liquor for the whole experiment. In the case of preparing it on the small scale, albumen or blood must be liberally used, and the liquor passed through paper filters—coarse French paper answers best. The albumen should not be added till all the sugar has been dissolved, and the temperature at, say, 160° F. An equal quantity of the prepared liquor, as nearly 180° F. as possible, must now be poured uniformly upon the char in each tube.

The rapidity with which the liquor passes through the chars in each case may be noted. Care must be taken to have the top of the char always covered with liquor, and the taps below open. As soon as the liquor begins to drop at the taps they are closed.

5. The tubes being fully charged with liquor (there should be as much left on the top of the char as will serve to force out the liquor in the char), they are put into a cistern of water at 140° F, the water in which will rise to about 1 inch from the mouths of the tubes, the time is noted, and the cisterns, which ought to be felted, covered.

6. At the end of not less than one hour (longer than one hour is sometimes advantageous, particularly if the raw liquor was very brown), the tubes are withdrawn, placed in their stand, and about 2 ounces of liquor run off each; this may be rejected, as the portion between the false bottom and tap is often turbid, and in addition has not been in contact with the char for a sufficient length of time. The remainder of the liquor, *i.e.*, so much as has actually been in contact with the char, may now be run off in three successive quantities for comparison. The results may be compared to any set of standard colours, and recorded accordingly.

7. If these results are not sufficiently instructive, a further quantity of raw liquor may be run on each tube, and the whole transferred as before to the water-bath, which, if felted, will still be hot enough. The second quantity of liquor will be run off with the same precautions as the first, and the results will show the *relative persistency* of the chars under trial.

If the taps are large the liquor will be likely to run off too rapidly, and, in that case, they had better be partially and uniformly closed.

If it is found that the liquor runs through one sample particularly slow, and through another particularly fast, it is quite admissible to assist the one by suction, and to check the other by closing the taps, but this should not be done unless in extreme cases, and the fact of having so assisted or retarded the process should always be noted.

It is scarcely necessary to mention the several points wherein the foregoing differs from the course usually pursued in testing chars, and yet it may be useful briefly to indicate some of these.

Too little care is usually bestowed upon the selection and preparation of the samples. The tubes used are, as a rule, too small: the char cannot be run so uniformly into small tubes as large ones. The samples once charged with liquor are not usually kept warm: it is essential that they should. Some chars act powerfully at low temperatures, while others require a considerable amount of heat to bring out their maximum decolourative power; care must, however, be taken that the temperature employed does not exceed that attained on the large scale in the refining process. The fact just noted does not seem to have been much investigated; it is worthy of careful consideration, not only on the part of experimentalists, but also by the practical refiner. One sample of char, known to be of very inferior decolourative power on the working scale, persistently gave results, by the usual method of testing in the laboratory, equal to the very finest chars obtainable, but when kept at an elevated temperature along with the finer samples, in the manner indicated above, its inferiority was at once manifest. The facts in this case were that the inferior char readily yielded *all* its decolourative power at the low temperature, while the finer samples required the influence of heat to call their whole power into action.

VI. The Constituents of Char, Important and Unimportant.

In the absence of a knowledge of the refining process, and the circumstances attendant on the use and revivification of animal charcoal, much time may be unprofitably spent over an analysis of that agent. While it is always desirable to have analyses carefully and accurately executed, the analyst should be able to discriminate between the essential and non-essential elements or compounds in the substance before him, and, while he aims at general accuracy, more than usual care should be bestowed upon substances the presence or absence of which mark the value of the agent under examination.

The points of greatest importance in an analysis of animal charcoal are the carbon, the carbonates, and the iron; the decolouriser, the neutraliser, and the destroyer. Under certain circumstances the sulphates may also be included in the list, and in the case of new unused char the alkaline salts should be carefully estimated. These essential points carefully ascertained, no modification of them should be thought of, whatever the phosphates may come out. If the analysis should come to 105, ten to one but the phosphates are to blame and not the carbon and carbonates. The phosphates are comparatively unimportant, and when it is remembered how various are the methods employed, and how faulty some of them are,* errors under that head need not be greatly wordered at. There is no excuse whatever for error in the carbon, the process is simplicity itself; the carbonates can be quickly and accurately estimated by the calcimeter (Note I.), while the iron, after some little practice, can be safely got at by Penny's process, using a very dilute solution of bichromate. The iron is always in the state of protoxide, faint traces of peroxide excepted, owing to the reducing action of the carbon in the re-burning. Of course, these remarks are intended to apply exclusively to commercial samples for use in the refinery. When char is to be sold for the manufacture of manure the circumstances are altered, and the phosphates become the essential element in the analysis.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

By M. GASTON TISSANDIER.

(Continued from vol. xx., p. 231.)

ANIMAL BLACK.

The consumption of animal black in sugar factories is very considerable; and this product now plays a prominent part in commerce. After having been used in the clarifying of sugar, animal black is sometimes employed in agriculture; but on this point we shall examine it more particularly in speaking of manures.

Ash.—The sample to be analysed is ground and sifted; 2 grms. are taken and calcined in a platinum crucible till the perfectly white residue contains no further traces of carbon. This residue, when weighed, gives the proportion of ash contained in 2 grms. of material. The carbon and moisture are given by difference. Care must be taken to moderate the heat in this calcination, so as not to decompose the carbonate of lime contained in the ash.

Carbon.—5 grms. of animal black are dried at 110° in a stove, or in a paraffin-bath; the loss of weight gives the moisture, which, subtracted from the loss by calcination, furnishes the proportion of carbon.

Silica.—The ash obtained by the calcination of animal black is dissolved in water acidulated with chlorhydric acid; it is slightly heated, and the insoluble siliceous remainder is filtered and weighed.

Phosphate of Lime.—To the filtered solution is added a slight excess of ammonia, which precipitates all the phosphate of lime ($PO_5,3CaO$); it is filtered, and the precipitate is dried, calcined, and weighed.

Carbonate of Lime.—The liquid, separated by filtration from the phosphate of lime, contains carbonate of lime, which is precipitated at the boiling-point by oxalate of ammonia. The precipitate of oxalate of lime is collected; this it is well to filter and wash by decantation, pouring the washing-water on the filter. The calcination of this precipitate necessitates, as is well-known, some precautions. The oxalate of lime must be heated to a sufficient temperature (approaching red-heat), to transform it into carbonate of lime; but the heat must not be so great as to decompose the residue of carbonate of lime. After having weighed the carbonate of lime, the operation may be controlled in the following manner:—The precipitate is moistened with sulphuric acid; it is calcined, in order to get rid of the excess of this acid, and the sulphate of lime obtained is weighed. This amount ought to correspond with the quantity of carbonate of lime, if the operation has been properly executed. Animal black contains traces of magnesia, which can be estimated in the form of ammonico-magnesian phosphate.

Soluble Salts.—50 grms. of animal black are weighed and thrown into a little stoppered flask containing about 50 c.c. of distilled water; this is well shaken for a few minutes, and then filtered. The insoluble residue is redigested in a fresh quantity of water; and this is repeated several times, so as to eliminate the whole of the soluble salts. The filtered liquid is evaporated over the sand-bath in a little porcelain capsule; the dry residue is weighed, and its weight gives the proportion of soluble salts. These salts consist of alkaline chlorides, sulphates, and carbonates; they also contain traces of sulphate of lime and sulphide of calcium.

Composition of Animal Black used in Sugar Refining.

Substances Estimated.	I.	II.	III.	
Water	2·00	1·37	1·21	Loss on calcination.
Carbon	8·42	9·90	11·12	
Carbonate of lime ..	14·92	13·80	12·22	Ash.
Phosphate of lime ..	72·50	72·25	74·43	
Silica	1·80	2·50	0·40	
Soluble salts	0·36	0·18	0·62	
Total ..	100·00	100·00	100·00	

Decolourising Power.—We have devised a method which enables us to compare the decolourising power of an animal black with that of another black of good quality, taken as a standard, and to represent the relation of the two decolourising powers by an exact number.

10 grms. of the standard black, and 10 of the black under assay, are weighed; the two samples, finely pounded, are placed separately on two filters of the same size.

A solution of caramel in water is prepared, so as to produce a rather dark colour, somewhat like that of weak tea. The first standard black is moistened with 20 c.c. of this solution, which runs through colourless; 20 more c.c. are passed through, and so on till the liquor passes coloured. When it presents just the same shade as the unfiltered solution of caramel, the operation is stopped.

The same experiment is made with the black under assay, placed on the second filter, and the quantity of solution required to be passed through until it is of the same colour noticed, as in the preceding experiment. Let us suppose that the standard black decolourised eight pipettes full of the caramel solution, and the black under assay only four: we say that the decolourising power of the latter is equal to one-half, relative to that of the former.

A solution of caramel may be kept ready prepared, so as so serve as a testing liquid.

ACETIC ACID.

Acetic acid, sometimes called, in commerce, pyroligneous acid, generally contains about 40 per cent of acetic acid, $C_4H_4O_4$; it is sold by the acidimetric standard, which is determined by means of a titrated alkaline liquid.

Acidimetric Standard.—Preparation of the Alkaline Liquid.—We have already shown how the alkalimetric sulphuric acid may be prepared accurately; this well-verified solution, containing 100 grms. of sulphuric acid per litre, is the basis of the preparation of the

* CHEMICAL NEWS, vol. xi., p. 49.

alkalimetric liquid which, in laboratories, is used to effect nitrogen determinations or to take acidimetric standards.

Any quantity whatever of pure caustic soda—15 or 18 grms., for instance—is dissolved in a litre of water. 10 centimetres of the normal sulphuric acid liquor (containing 1 grm. of SO_3HO) are taken and poured into a small precipitating glass; to this is added some sensitive tincture of litmus, and the solution of caustic soda poured into it drop by drop by means of a graduated burette, divided into tenths of c.c., till the red litmus becomes blue—that is to say, till the acid is saturated. Let us suppose that 50 c.c., or 500 divisions, of our alkaline solution are required to saturate 10 c.c. of the titrated sulphuric acid liquid. We know that 500 divisions saturate 1 grm. of sulphuric acid, and we can calculate, according to the equivalents, what quantity of acetic acid will saturate a certain volume of our liquid; we know, for example, that 500 divisions ought to saturate 1·224 grms. of acetic acid, $C_4H_4O_4$:—in fact, $\frac{49(SO_3,HO)}{60(C_4H_4O_4)} = \frac{1.}{x}$

Before thus standardising the alkaline liquor of caustic soda, it is well to add some slaked lime, to prevent it from carbonating, which would interfere with the sharpness of the colouration of the red litmus into blue. Before using this liquor, the bottle which contains it is shaken, and left to settle, so that the lime may be deposited at the bottom; the solution, becoming clear in a few minutes, is then poured into the graduated burette, which is used to take the standard of pyroligneous acid under assay.

According to arrangement between the buyer and seller, the standard of this acid is taken either by *volume* or by *weight*. In the former case, 1 c.c. of acetic acid is saturated, in the latter 1 grm.

In order to take the standard by weight, a small glass, containing in it a 10-grm. weight, is tared on a sensitive balance. Equilibrium being established, the 10-grm. weight is taken out, and the acetic acid to be tested is then gradually poured into the glass by means of a small tube, so as to regain the equilibrium. We have thus, by double weighing, obtained 10 grms. of acetic acid, which are to be diluted with water so as to give a volume of 100 c.c.

After this solution has been rendered homogeneous by shaking, 10 centimetres of it are removed, corresponding to 1 grm. of acetic acid. Instead of directly weighing 1 grm. of the acid to be tested, it is better to weigh 10 grms. of it, as we have indicated; because, in case of a verification being needed, it is easier to measure 10 c.c. than to commence a fresh weighing.

The 10 centimetres deducted are placed in a precipitating jar, litmus is added, and the alkaline soda liquid poured in, drop by drop, till the litmus becomes clearly blue. If 150 divisions have been used, we shall obtain the acidimetric standard of pyroligneous acid by the following equation:—

500 divisions saturate .. .. 1·224 grs. of $C_4H_4O_4$
150 „ will saturate .. x.

whence—

$$x = 0{\cdot}3672.$$

100 grms. of the assayed acetic acid contain, then, 36·72 grms. of $C_4H_4O_4$, which is expressed by saying that its standard is 36·72°.

When the standard is taken by volume the operation is the same; only, instead of weighing 10 grms. of the acid, 10 c.c. are measured.

Examination for Mineral Acids.—Acetic acids are sometimes adulterated with mineral acids (chlorhydric and sulphuric, &c.), which augment their standard.

To detect their presence, 50 c.c. of acetic acid are heated to the boiling-point with 1 or 2 centigrms. of starch, and left to boil about twenty minutes. When the liquid has become cold, some drops of tincture of iodine are poured into it. If a blue colouration of iodide of starch occurs, the acetic acid contains no mineral acids; but if this colouration is not produced, we may be certain of the presence of mineral acids, which, under the action of heat, have transformed the starch into dextrine, and thus prevented the formation of the iodide. Care must be taken to pour the iodine into the cold liquid, for iodide of starch is decolourised spontaneously under the action of heat. Chlorhydric acid may also be immediately detected, by adding to the acetic acid a few drops of nitrate of silver; and the presence of sulphuric acid is discovered by chloride of barium. In the latter case, it must not be forgotten that chloride of barium is insoluble in acids, and that the acetic acid ought to be diluted with a sufficiently large quantity of water to avoid the possibility of error from this cause.

Pyroligneous acids generally standardise 39° to 40°; however, this figure is not absolute. We have sometimes met with samples containing only 34 per cent of acetic acid, others having 46 to 50 per cent, and even still larger quantities.

(To be continued).

ON THE

METHOD OF ANALYSING SILICATES THAT DO NOT GELATINISE WITH HYDROGEN CHLORIDE.*

By NEVIL STORY-MASKELYNE, M.A.,
Professor of Mineralogy in the University of Oxford, and Keeper of the Mineral Department, British Museum.

THE process is conducted in an apparatus of the following constructions:—A platinum retort, 30 c.c. in capacity, is fitted with a tubulated stopper of the same material, which reaches nearly to the bottom; a small tube, entering the vertical tube of the stopper at an angle above the neck of the retort, conveys hydrogen to its interior. The vertical tube can be closed, either by a stopper of platinum or by a funnel of that metal, stopped in like manner at the top, and having a fine orifice at its lower extremity.

To the side of the retort, just below its neck, a straight delivery-tube is fixed, which in its turn fits into another platinum tube that, after taking a curve into a vertical position, is enlarged into a cylinder, which passes a considerable distance down a test-tube. The latter, into which the delivery tube is fitted with a cork, holds 7·5 c.c., or 6·6 grms. of strong ammonia of the sp. gr. 0·88.

The gas-delivery tube inserted in the side of this receiver dips into some more ammonia in a second test-tube.

The pounded mineral, from 0·2 to 0·5 grm. in quantity, and a small platinum ball, are placed in the retort, and the stopper luted to it with gutta percha, and cemented air-tight in its place with caoutchouc and gutta-percha varnish. The funnel, filled with perfectly pure hydrogen fluoride, is now introduced into the tubulure of the stopper, the tap opened, and the acid allowed to run down into the retort. This acid contains about 32 per cent of absolute hydrogen fluoride—that is to say, a funnel of this reagent contains 1·12 grms. of acid, capable of rendering gaseous 0·84 grm. of silica, and of neutralising 0·95 grm. of ammonia. The funnel is now replaced by a little platinum stopper, and the orifice secured air-tight with gutta-percha varnish. Pure hydrogen is then allowed slowly to traverse the entire apparatus; the retort is placed in a water-bath at 100° C. for two hours, and occasionally slightly shaken to set the ball rotating. During the operation, a trace only of silicium difluoride passes over.

The retort is next transferred to a paraffin-bath, and the temperature is cautiously raised. At first, hydrogen fluoride passes over, and at this point of the process the flow of hydro-

* Extracted from a paper "On the Mineral Constituents of Meteorites," communicated to the Royal Society.

gen requires some attention to prevent regurgitation of the ammonia. At about 132° C., in the case of the silicates mentioned in this memoir, the silica first becomes visible in fine flocks in the ammonia of the receiver, and in another minute the whole is cloudy.

In eight minutes, the rise of the thermometer to 145° C. has brought over so much difluoride that the contents of the tube are semisolid, and nearly the whole of it has passed over. The temperature is then raised to 150° C., and the retort allowed to cool. The process is next repeated with a fresh charge of acid and ammonia. If no more than 0·2 grm. of silicate be taken, twice charging of the retort is sufficient; but with 0·5 grm., three or four repetitions of the process are required. In short, the operation is continued with fresh reagents till no flock of silica forms in the receiver. Finally, 0·75 c.c. of sulphuric acid is introduced into the retort, and the temperature again raised to 160° C., the stream of hydrogen being continued as before.

The several ammoniacal charges are poured into a platinum dish, together with the washings of the delivery-tube and the two test-tubes, and slowly evaporated in a water-bath with continued stirring.

At a point in the evaporation just before the solution becomes neutral, and the ammonium fluoride begins to turn acid, the entire silica in the dish will have been dissolved by the fluoride. The process is gradual, but the moment when the solution is complete is easily determined. Then, the dish being removed, potassic chloride is added in slight excess, together with absolute alcohol equal in volume to the contents of the platinum vessel. Potassium fluosilicate precipitates, which, after the lapse of twenty-four hours, is filtered, weighed with a mixture of equal volumes of absolute alcohol and water, dried, and washed. The results are accurate. In the retort are the bases in the form of sulphates, the treatment of which calls for no further remark.

ON FLUORIDE OF SILVER.*

By GEORGE GORE, F.R.S.

This communication treats of the formation, preparation, analysis, composition, common physical properties, and chemical behaviour of fluoride of silver.

The salt was prepared by treating pure silver carbonate with an excess of pure aqueous hydrofluoric acid, in a platinum dish, and evaporating to dryness, with certain precautions. The salt thus obtained invariably contains a small amount of free metallic silver, and generally, also, traces of water and of hydrofluoric acid, unless special precautions mentioned are observed. It was analysed by various methods. The best method of determining the amount of fluorine in it consisted in evaporating to dryness a mixture of a known weight of the salt, dissolved in water with a slight excess of pure and perfectly caustic lime in a platinum bottle, and gently igniting the residue at an incipient red heat until it ceased to lose weight. By taking proper care, the results obtained are accurate. The reaction in this method of analysis takes place according to the following equation:—

$$2AgF + CaO = CaF_2 + 2Ag + O.$$

Sixteen parts of oxygen expelled equal 38 parts of fluorine present. One of the methods employed for determining the amount of silver consisted in passing dry ammonia over the salt in a platinum boat and tube at a low red heat. The results obtained in the various analyses establish the fact that pure fluoride of silver consists of 19 parts of fluorine and 108 of silver.

Argentic fluoride is usually in the form of yellowish-brown, earthy fragments; but, when rendered perfectly anhydrous by fusion, it is a black, horny mass, with a superficial satin lustre, due to particles of free silver. It is extremely deliquescent and soluble in water. One part of the salt dissolves in 0·55 part by weight of water at 15·5° C.; it evolves heat in dissolving, and forms a strongly alkaline solution. It is nearly insoluble in absolute alcohol. The specific gravity of the earthy-brown salt is 5·852 at 15·5° C. The specific gravity of its aqueous solution, 15·5° C., saturated at that temperature, is 2·61. By chilling the saturated solution, it exhibited the phenomenon of supersaturation, and suddenly solidified, with evolution of heat, on immersing a platinum plate in it. The solution is capable of being crystallised, and yields crystals of a hydrated salt. The act of crystallisation is attended by the singular phenomenon of the remainder of the salt separating in the anhydrous and apparently non-crystalline state, the hydrated salt taking to itself the whole of the water. The fused salt, after slow and undisturbed cooling, exhibits crystalline markings upon its surface.

The dry salt is not decomposed by sunlight. It melts below a visible red heat, and forms a highly lustrous, mobile, and jet-black liquid. It is not decomposed by a red heat alone; but, in a state of semi-fusion, or of complete fusion, it is rapidly decomposed by the moisture of the air, with separation of metallic silver. Dry air does not decompose it. In the fused state, it slightly corrodes vessels of platinum, and much more freely those of silver.

The salt, in a state of fusion, with platinum electrodes, conducts electricity very freely, apparently with the facility of a metal, and without visible evolution of gas or corrosion of the anode. A silver anode was rapidly dissolved by it, and one of lignum-vitæ charcoal was gradually corroded. A saturated aqueous solution of the salt conducted freely with electrolysis, crystals of silver being deposited upon the cathode, and a black crust of peroxide of silver upon the anode; no gas was evolved. With *dilute* solutions, gas was evolved from the anode. By electrolysis of anhydrous hydrofluoric acid with silver electrodes, the anode was rapidly corroded.

The electrical order of substances in the fused salt was as follows, the first-named being the most positive:—Silver, platinum, charcoal of lignum-vitæ, palladium, gold. In a dilute aqueous solution of the salt, the order found was:—Aluminium, magnesium, silicon, iridium, rhodium, and carbon of lignum-vitæ, platinum, silver, palladium, tellurium, gold.

The chemical behaviour of the salt was also investigated. In many cases, considerable destruction of the platinum vessels occurred, either in the experiments themselves, or in the processes of cleaning the vessels from the products of the reactions.

Hydrogen does not decompose the dry salt, even with the aid of sunlight; nor does a stream of that gas decompose an aqueous solution of the salt; but the dry salt is rapidly and perfectly decomposed by that gas at an incipient red heat, its metal being liberated.

Nitrogen has no chemical effect upon the salt, even at a red heat, nor upon its aqueous solution. Dry ammonia gas is copiously absorbed by the dry salt. In one experiment, the salt absorbed about 844 times its volume of the gas. The salt, in a fused state, is rapidly and perfectly decomposed by dry ammonia gas, and its silver set free. A saturated solution of the salt is also instantly and violently decomposed by strong aqueous ammonia.

Oxygen has no effect either upon the dry salt at 15° C. or at a red heat, nor upon its aqueous solution. Steam perfectly and rapidly decomposes the salt at an incipient red heat, setting free all its silver. No chemical change took place on passing either of the oxides of nitrogen over the salt in a state of fusion.

By passing anhydrous hydrofluoric acid vapour over perfectly anhydrous and previously-fused fluoride of silver, at about 60° F., distinct evidence of the existence of an acid salt was obtained. This acid salt is decomposed by slight elevation of temperature.

Numerous experiments were made to ascertain the

* Abstract of a paper read before the Royal Society.

behaviour of argentic fluoride, in a state of fusion, with chlorine; and great difficulties were encountered, in consequence of the extremely corrosive action of the substances when brought together in a heated state. Vessels of glass, platinum, gold, charcoal, gas carbon, and purified graphite were employed.* By heating the salt in chlorine, contained in closed vessels formed partly of glass and partly of platinum, more or less corrosion of the glass took place, the chlorine united with the platinum and fluoride of silver to form a double salt, and a vacuum was produced. By similarly heating it in vessels composed wholly of platinum, the same disappearance of chlorine, the same double salt, and a similar vacuum resulted. Also, by heating it in vessels composed partly of gold, an analogous double salt, the same absorption of chlorine, and production of rarefaction was produced. And, by employing vessels partly composed of purified graphite, a new compound of fluorine and carbon was obtained.

ON MICROSCOPICAL MANIPULATION.†

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 21).

Another contrivance, and one which has the recommendation of being procured at a very small cost, is the *neutral tint reflector* (Fig. 40).* It consists of a small plate of glass, with surfaces accurately parallel, and slightly coloured, so as to improve its reflecting qualities, but not sufficiently dark to prevent the paper from being easily seen through it. This is placed, as before, at an angle of 45°. As the instrument is commonly constructed, the tinted glass is a fixture, and the setting too long; so that the mirror is removed to a greater distance than is advantageous from the front glass of the eye-piece; this contracts the field so much, when any but an eye-piece of low power is employed, that it is almost useless. This defect is remedied in the form here represented, in which the mirror is brought as close as possible to the eye-glass. The tinted glasses are also removable, so that a change of tint may be made, as it will be found sometimes that one tint suits the eye better than another. Some microscopists, instead of tinted glass, use a piece of thin cover-glass, which gives a very good reflection, and can easily be used with this form of setting, which also allows a small right-angled prism to be placed in it, and which, although not usually supplied with the instrument, will be found a serviceable addition. Its use will be described with that of the preceding instruments. This reflector gives a reversed view of the object by a single reflection, as in the steel mirror of Soemmering, but, unlike it, the paper, instead of being viewed round its edge, is seen through the glass.

Fig. 40.

As these instruments have much in common, the use of them may very conveniently be described together, noticing, in passing, such peculiarities as render them more or less serviceable, each having its own special advantages and defects.

The microscope should be placed with the body in a horizontal position (Fig. 41), and, if the stand is not of suitable height, it should be placed on a box or other convenient support. The best distance between the eye and the paper, for general purposes, is 10 inches, this being the standard distance employed in estimating magnifying power; but any other that is convenient may be made use of, bearing in mind that the greater the distance from the eye-piece the larger will be the image; so that the size of the picture is capable of being regulated at will, the only limit being the difficulty of seeing the pencil when too near, and the trouble of drawing with a pencil attached to a long stick if the paper is greatly removed from the usual position.

Fig. 41.

With respect to the images formed by the several instruments, the camera lucida, as it reflects doubly, has the advantage of giving the image in the same position as when viewed through the micro-

* In the next communication there will be described the results obtained with vessels formed of other materials.

† The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

scope directly, which, owing to its perfect internal reflection, is brilliant and well defined. Soemmering's mirror and the tinted-glass reflector reverse the image, just as an ordinary looking-glass. This is of little consequence if only slight outline sketches are required; but, when the drawing is to be highly finished, which is always done by viewing the object directly through the microscope, this reversal becomes excessively troublesome to those who are not, like engravers and lithographers, accustomed to reverse their drawings.

With a view to obviating this inconvenience, the author uses the small right-angled prism before mentioned, when drawing with the neutral tint reflector, which enables the drawing to be completed, as it reverses the image just as the tinted glass; and, as the reflection from the internal surface of the prism is total, the view is nearly as brilliant as that received directly from the microscope.

Only one eye is to be used while drawing, and great care should be taken to maintain its position steadily until the sketch is finished (Fig. 41). With the camera lucida and Soemmering's mirror, the maintenance of this position is somewhat painful, when much prolonged, owing to the divided manner in which the eye receives the light from the object and the paper; and frequently the power of seeing the pencil and drawing is lost after a few minutes' use. With the neutral tint reflector, the view of both object and paper is much easier; and, when the reversal of the picture is immaterial, it is, as far as comfort is concerned, much to be preferred.

The illumination is a matter of great importance in making use of drawing instruments. Care should be taken not to light the object more than is necessary, while it will generally be found advisable to illuminate the paper rather strongly. If the image of the object is too bright, it will be found impossible to see either the pencil-point or the line it is tracing. The camera lucida requires far more care, in this respect, than the tinted mirror.

The author's practice is always, when drawing, to use two lamps; one the little camphine lamp before mentioned (Chemical News, vol. xx., p. 158), which is used exclusively for the microscope; the other a large paraffin lamp, with shade, which lights the paper. By this means, the relative illumination of the object and paper can be very nicely adjusted—a matter of some difficulty when only one lamp is employed.

These instruments are only used to secure an outline, and mark out other main points, the details being filled in by free-hand drawing, which will be found comparatively easy when an accurate outline is obtained to work upon.

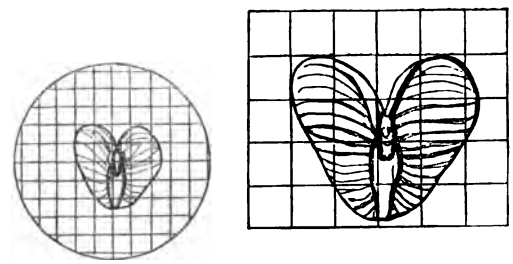
If, when the sketch is finished, before removing the reflector, a ruled micrometer-scale is placed upon the stage of the microscope in the place of the object, the lines can be seen projected upon the paper, just as any other object, and, by tracing some of them, a scale can be formed by which the drawing can readily be measured with a pair of compasses, like a map. This is one of the simplest methods of micrometry.

The magnifying power of the microscope can also easily be ascertained by means of the camera lucida or neutral tint reflector and the stage micrometer. By placing the microscope in the position for drawing, taking care that the eye-piece is 10 inches from the paper, the image of the micrometer-lines, instead of being projected on a sheet of paper, is caused to fall upon a divided scale; and, from the amount covered by it, the magnifying power can be estimated; for instance, the 1-inch objective, with No. 1 eye-piece, causes 0·01 of the micrometer to cover 0·5 inch of the measure on the table; the magnifying power will be 50 diameters. The ½-inch makes 0·01 cover 2·5 inches; the power will be 250 diameters. And so on, for other objectives and eye-pieces.

Finding the placing of the microscope in a horizontal position troublesome, and not liking the constraint of the camera lucida, the author thought that the method of enlarging and reducing drawings commonly employed by artists might be adapted to the microscope. This process consists of ruling a series of squares of convenient size on the drawing to be copied, or placing over it a lattice of threads crossed in squares. The copy is then made upon a sheet of paper or other material, ruled, either in augmented or diminished proportion, as may be required. Messrs. R. and J. Beck ruled a disc of glass in squares (Fig. 42), the side of each of which,

Fig. 42.

A B



for convenience sake, was made to correspond with 10° of Jackson's eye-piece micrometer. This disc was dropped into the eye-piece, and rested on the stop, so that, when in use, the field appeared similarly divided (Fig. 42, A). A sheet of paper (Fig. 42, B), ruled in squares of convenient size was employed to make the drawing upon; and, by noticing how many squares the object covered, the direction of the various lines, whether, for instance, they ran through the sides or the corners of the squares, and setting them down in similar positions on the ruled sheet, the author found that an accurate drawing might be made with great ease and expedition, and without the trouble of moving the microscope out of the usual inclined position, which is generally the most comfortable for observation. The use of the binocular did not cause any impediment, and the ruled disc only slightly interfered with the definition of the object, and could easily be removed, when its services were no longer required, without disturbing the arrangement of illumination, object, or instrument. When large diagrams are wanted, nothing more is necessary than to use a large sheet of paper, ruled in squares of suitable dimensions, and the object can be rapidly delineated in this augmented proportion.

The measurements can be made either by obtaining the value of the side of a square of the disc with each objective and eye-piece, by means of the stage-micrometer, or by selecting two well-marked dots or lines in the objects, and measuring their distance with the eye-piece micrometer, and using the distance obtained from the corresponding part of the drawing

as a standard for the formation of a scale. These processes will be explained in the account shortly to be given of micrometers.

When many sheets of paper are required to be ruled in squares (and it will be found in practice that two or three sizes will be in general request), they can easily be made by placing a perforated sheet over the sheet to be ruled, and rubbing over it a piece of wash-leather dipped in black-lead powder, which will pass through the holes and leave a series of dotted lines on the sheet below, which will be sufficiently distinct, and have the advantage of being rubbed out with a very light touch of the india-rubber, without affecting the pencil-lines of the drawing. The perforated sheets are easily made by means of a comb-like steel punch used by harness-makers, which cuts a row of small pin-holes, equal in length to its own width, which may be an inch or more. This instrument can be obtained at the better class of tool-shops.

Some microscopists have endeavoured, with more or less success, to make drawings from the image of the object projected upon a sheet of paper or ground glass, after the manner of the solar microscope or camera obscura. All the contrivances for this purpose seem to have the defect of giving a very faint image, unless a light of greater intensity than that of ordinary lamps is employed. The image must be received in the dark, which is troublesome, as the outline cannot easily be seen. The process is only applicable to those objects which can be viewed by transmitted light, besides putting the microscope more out of its usual position than the camera lucida and other reflecting instruments.

(To be continued.)

DUBOSCQ'S NEW COLORIMETER.*

M. DUBOSCQ has submitted to the Academy of Sciences his new colorimeter for measuring the differences of tint in solutions. The two liquids are placed in the two cylindrical vessels, C, C', of glass, fixed side by side, before the vertical shelf of the colorimeter.

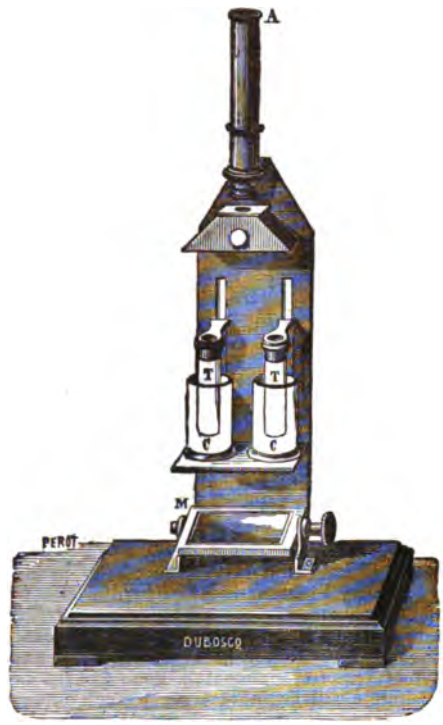
In the two vessels, two tubes of smaller diameter, T, T', closed at the lower extremity by a disc of glass, may be raised and lowered by means of the movable pinions engaged by two racks cut into the vertical table. To each pinion is fastened a vernier, which is moved under a graduated scale, and which measures the distance between the bottom of the vessels and the lower disc of the movable tube.

The luminous rays transmitted by the two columns properly illuminated by a mirror, M, placed above, and moved around in a horizontal axis, suffer each two reflections, within one of Fresnel's rhombs, P, P', and then arrive in the same field of vision, in such a manner that each shall illuminate the half of the field with a semi-disc or circle of yellow colour, more or less intense. These colours are observed with a small lens, which is nothing but the base of a terrestrial eye-piece, formed of four glasses, and which magnifies sufficiently, so that the field may be illuminated by the coloured plates with perfect uniformity.

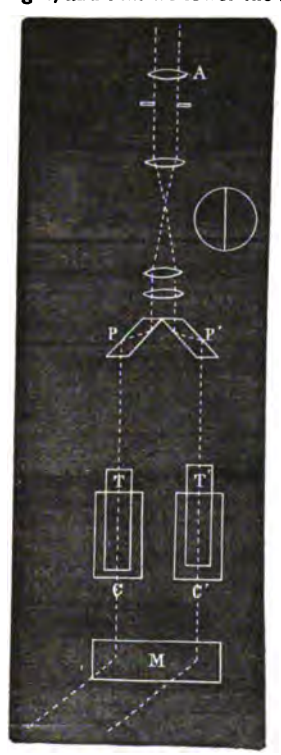
The colours are proportional to the height of the columns if the liquid contain the same proportion of caramel; or proportional to the richness of the liquid in caramel, if the two columns have the same height.

* For this description as well as for the illustrative cuts we are indebted to the courtesy of Professor Morton.

In the last case, if we cause the height to vary, we have the same shade on these two semi-discs.



Suppose that the standard solution is in the cup to the right, and that we lower the interior disc or movable tube to 20 millimetres from the bottom of the cup; we will thus have a column of 20 millimetres, which gives to the half disc of the left-hand side a pale yellow colouration. Admitting, then, that the half disc at the right has the same colouration, but that the column of the liquid placed in the cup to the left has not a height of 40 millimetres, this informs us that the solution to be tried contains a proportion of caramel more than that contained in the standard liquid.



In fact, for the same colour on the two semi-discs, the proportions of caramel contained in the two liquids are inversely as the height which we give to the column of the liquids.

One hundred centimetres of the solution tried, contained, then, in the case we speak of,

$$\frac{0 \text{ gr. } 2}{2}$$

of caramel.

If we have dissolved, for

example, 10 grammes of syrup in 100 c.c. of water, we should know that 10 grammes of the syrup contained one d. c. g. of caramel.

NOTICES OF BOOKS.

Addresses at the Inauguration of Charles William Eliot as President of Harvard College, Tuesday, October 19, 1869. Cambridge (Mass.): Sever and Francis. 1869. 65 pp., 8vo.

ON the 19th of September, 1868, Dr. Thomas Hill resigned the office of President of Harvard College; and on the 19th of October, 1869, Mr. Charles William Eliot was formally inducted into office in his stead. Mr. Eliot is known to many of us as a writer on chemistry: to some of us as a man of singularly sound and accurate thought, of high culture and of liberal views, and as a kindly genial gentleman. Let us glance for a moment at the addresses which were delivered at the inauguration of Mr. Eliot, and specially at his own, which derives additional interest from the fact that he has paid special attention to the subject of education, and has watched the growth of the educational system of his own country, comparing it with those of the principal European nations, and particularly with our own college system.

The form of induction into office of the president of a college is very different in America from that which is adopted in England. In the invitation to the Alumni of Harvard College, it is stated that "A procession will be formed in Gore Hall, at half-past two p.m., under the direction of Leverett Saltonstall, Esq., and the exercises in the Church will begin at three o'clock p.m. Immediately after the exercises in the church, President Eliot will hold a reception at the President's House in Quincy Street." The "Exercises" on this occasion were nine in number, and consisted of:—

1. "Music by the Band.
2. Choral: 'Let us with a gladsome mind.'
3. Prayer by the Rev. Dr. Peabody.
4. Congratulatory Address in Latin, by John Silas White, of the Senior Class.
5. Induction into Office, by John Henry Clifford, President of the Board of Overseers.
6. Chorus: 'Domine, salvum fac Præsidem Nostrum.' —J. K. Paine.
7. Address by President Eliot.
8. Chorus from the Antigone of Sophocles: 'Πολλα τα δεινα κουδεν ανθρωπου δεινοτερον πελει.' 'Wonders in Nature we see.'—Mendelssohn.
9. Benediction, by Rev. Dr. Walker."

The Latin address is, as we should expect, less florid and elaborate than those which are given on somewhat similar occasions in the French and German Universities; the "Amplissimi, Nobilissimi, Præstantissini Eminentissimi," commencement is omitted, and it begins simply and to the point, "Convenimus hodie," while it is concluded by an exceedingly apt and reverent phrase:— "Precamur autem a Deo Optimo Maximo ut signis illis venustis ac pulchris, quæ verbo inter se discrepantia, re prorsus unum videntur sonare, semper tu et nos, ut diligimus, sic utamur,—'Christo et Ecclesiæ' atque 'Veritas.'"

In the Inductory Address, Mr. Clifford alludes to certain changes recently made in the constitution of the College—notably, the separation of the College from the State—a change "which has wisely taken from the Legislature and confided to the Alumni of the College, the choice of the Board of Overseers." It has also given the College a greater independence, since it now stands alone, unsupported by the State, and is dependent upon itself for the maintenance of the position which, as the oldest American University, it ought to occupy. Mr. Clifford then speaks of the power committed to the President, and of the nature and result of his influence upon the Alumni; he advocates a system of "personal examination, by which the Faculty might test the student's disposition to make the best of his opportunities, according to his capacity," in place of the unjust system of arbitrary marks by which mediocrity is too often crushed out by genius. "Mediocrity," he truly remarks, "is the unattractive average of the race; though its capabilities, wisely stimulated and diligently cultivated, constitute the working forces of the world. Genius, with its brilliant, but often erratic efforts, is the rare exception in human endowment. The former needs all the fostering and patient care the teacher can bestow; the latter is self-reliant and sufficient unto itself." When the Fathers of New England who founded Harvard College inscribed VERITAS upon its seal, to which was soon added CHRISTO ET ECCLESIÆ, "they surely never dreamed," says Mr. Clifford, "that there is an irrepressible conflict between the truths of ethical and physical science."

Passing now to the address of the new President, let us notice the treatment of matters of faith and reason, considered in regard to an educational system, by a man of great general, and of special scientific culture. The President (and he here speaks also of the University) allows no antagonism between literature and science; he makes no distinction. Instruction is not to be specialised—it is to be general, and the University is not concerned with applications of knowledge: "truth and right are above utility in all realms of thought and action." The subject-matter of learning must be augmented, not diminished. In America specially learning must be broadened and invigorated, for it will require many generations before it will bear pruning. "Recent discussions have added pitifully little to the world's stock of wisdom about the staple of education. Who blows, to-day, such a ringing trumpet-call to the study of language as Luther blew? Hardly a significant word has been added in two centuries to Milton's description of the unprofitable way to study languages. Would any young American learn how to profit by travel, that foolish beginning but excellent sequel to education; he can find no apter advice than Bacon's. The practice of England and America is literally centuries behind the precept of the best thinkers upon education." The problem is not what to teach, but how to teach. With an improved system, Mr. Eliot thinks that a man of twenty-five ought to have a good general knowledge of all the main subjects of human knowledge, and a thorough knowledge of the one subject which is to engage his professional after-life. There are special modes of thought belonging to each special branch of learning, and a young man ought to have some actual experience of each.

As to the subjects taught in the American universities, Mr. Eliot tells us that the course of study has of late been enriched and enlarged. "The University believes in the thorough study of language. It contends for all languages—Oriental, Greek, Latin, Romance, German, and especially for the mother-tongue; seeing in them all one institution, one history, one means of discipline, one department of learning. . . . The University recognises the natural and physical sciences as indispensable branches of education, and has long acted upon this opinion; but . . . . . the prevailing methods of teaching science, the world over, are, on the whole, less intelligent than the methods of teaching language. The University would have scientific studies in school and college, and professional school develop and discipline those powers of the mind by which science has been created and is daily nourished—the powers of observation, the inductive faculty, the sober imagination, the sincere and proportionate judgment." He next speaks of mathematics, of history, of mental, moral, and political philosophy. The latter of these should not be taught with authority,

because they are full of disputed matters, and because "exposition, not imposition, of opinions is the professor's part."

The admission—or, as we should say, matriculation—examination at Harvard College is something similar to the first examination in the University of Paris; but, for the first degree in Arts, no less than four years' study are requisite. We have another proof of the difficulty of obtaining this degree in the fact that one-fourth of the total number of students who enter the College fail to take it. Of these four years, the first is devoted to certain fixed subjects, through which all fresh men pass; but, during the other three years, more than half the time is given to subjects chosen by the student from lists. Six studies may be thus chosen for the second year, nine for the third year, and eleven for the fourth year of college life. This so-called "elective system" has been found to work well, and President Eliot proposes to extend it. Harvard possesses among her students men of the most varied conditions in life, and of the most varied means. Many men enter yearly without any resources at all; but, so long as they exhibit aptitude for learning, and are of good character, they are never refused admission on account of their poverty. Every year, a sum of more than 20,000 dollars is expended in helping poor students to complete their university education; and, in addition to this, there are many private grants of money. "No capital," says Mr. Eliot, "earns such interest as personal culture. . . . . The poverty of scholars is of inestimable worth in this money-getting nation. It maintains the true standards of virtue and honour. The poor friars, not the bishops, saved the church."

Harvard College is governed by the Board of Overseers, the Faculties, and the Corporation. During the last three years, the overseers have been chosen by the Alumni, and five are elected each year to serve for six years. Their duty is to inspect the University, and to watch the actions of the President and Fellows. The Corporation makes all appointments, fixes salaries, and acts as Treasurer. It holds all public trusts and grants, and invests all unemployed moneys of the University. It should always be seeking "how safely to make a quarter of a per cent more: a quarter of one per cent means a new Professorship." The President is a member both of the Board of Overseers and of the Corporation, as, also, of all the Faculties. His chief duty is that of supervision; he has, further, to advise the Corporation in the matter of appointments. As regards the teachers: "the Corporation demands of all its teachers that they be grave, reverent, and high-minded; but it leaves them, like their pupils, free." A University is built, not by a sect, but by a nation.

Here, then, we have, in brief, the outlines of the mode of working of a university "intensely American in affection, and intensely democratic in temper." We can scarcely attempt here so large a scope as a comparison of it with our own or foreign universities, for the character of such an institution is always profoundly influenced by the character and conditions of the people for whom it exists. A strict comparison on equal terms hence becomes impossible, and a comparison, without an even balance of existing influences and qualities, unfair. Yet we would presume to say that many of our European universities might, with advantage, adopt some of the regulations of Harvard; and that a reverse interchange would be beneficial is admitted by the New England Cantabs themselves. Harvard University has grown greatly during this century, and we doubt not but that it is destined to play an important part in the culture of the New World. The new President, whose life has been linked with that of the University, whose judgment has been ripened by travel and by residence in Europe, and who possesses a singularly healthy tone of thought, combined with refined intellectual tastes, has been well chosen for the furtherance of this destiny.

Geologie Comparée: Etude Mineralogique du fer Météorique de Deesa. Par M. Stanislas Meunier, Docteur ès Sciences, &c. Paris: F. Savy, 24, Rue Hautefeuille.

This pamphlet is a reprint of a series of articles which have appeared in *Cosmos*. The headings of the chapters are:—"Description and Chemical Analysis of the Iron of Deesa;" the latter name refers to a locality in the Cordilleras Mountains, in Chili. "Mineralogical Analysis of the Meteoric Mass;" from this portion we learn that the meteorite referred to contains no less than eleven different well-defined mineralogical species. "Comparison of the Deesa Meteorite with Divers Types of Meteorites." "Conclusions Drawn from the Investigation;" this portion of the paper informs us that it is possible to come to some knowledge of the geological age meteorites belong to, since the author states that our globe contains what he terms eruptive meteoric rocks. The Deesa meteorite is stated to be remarkable, because it is the first instance met with of an extra-terrestrial dyke (*filon*). The pamphlet is well printed, and is issued on a better kind of paper than is usual with our courteous French neighbours.

CORRESPONDENCE.

GMELIN'S CHEMISTRY.

To the Editor of the Chemical News.

Sir,—In reply to the letter signed "Reference," which appeared in your last number, and for the the satisfaction of many persons who are interested in the completion of Gmelin's "Handbook," I beg to be allowed to make the following statement.

About 200 pages of the concluding volume are already translated; but, for the remainder, we have to wait the pleasure of the German editor and publishers, whose movements are not very expeditious. The conclusion was promised last year, but has not yet appeared; when it comes to hand, the translation will be completed with all possible despatch.

The much desired index is in progress, and a considerable portion is already compiled; but its completion must, of course, depend on that of the work itself.—I am, &c.,

Henry Watts.

151, King Henry's Road, N.W.
January 17, 1870.

PRESENCE OF LEAD IN WINE.

To the Editor of the Chemical News.

Sir,—This week's Chemical News contains a paper by Professor Storer, "On the Simultaneous Occurrence of a Soluble Lead Salt, &c., &c., in Sherry Wine." This paper will lead many to believe that the addition of litharge and sulphuric acid to wine is by no means a rare occurrence, and may thus needlessly alarm some, and cast an undeserved slur upon others. I would, therefore, with your permission, make a few remarks on the above paper.

The addition of litharge to wine, for the purpose of removing acidity or for any other purpose, is, I believe, never practised at the present day, if, indeed, it ever was a practice. The belief that such a practice exists is nothing more than an old tradition, kept alive by the occasional finding of lead in some sample of wine.* In most or all of these cases, when properly investigated, the presence of lead may be proved to result from carelessness, and is not due to wilful addition of litharge for purposes of improvement; indeed, wine could not be thereby improved.

* *Query*, Has the name *sugar* of lead, by which acetate of lead is popularly known, anything to do with this belief in the use of litharge as sweetening matter?

For instance, the wine has been run through leaden pipes; has been filled into bottles cleaned with shot, some of which have stuck in the bottle; or has, in some other similar manner, come into contact with lead, and been impregnated by it.

Again, the presence of small quantities of free sulphuric acid is of very frequent occurrence in sherry, and, in fact, in many other wines. Its presence is easily accounted for without the hypothesis of its addition for the purpose of removing lead. It is now well known that plaster-of-Paris is very frequently added to *must*, and its action on cream of tartar yields tartrate of calcium, sulphate of potassium, and sulphuric acid, part of the latter remaining free if the other salts are not sufficient to neutralise it.

Lastly, the solubility of sulphate of lead in tartrate of ammonium is a well-known fact, and has been long employed in analytical chemistry for the purpose of separating sulphate of lead from sulphide of mercury and sulphur.—I am, &c.,

A. DUPRE, Ph.D.

Westminster Hospital,
January 15, 1870.

MISCELLANEOUS.

The Troppmann Trial.—One of our correspondents has the kindness to call our attention to a portion of the evidence of Prof. F. Roussin, which we translate. Speaking of the abdominal viscera of the corpse of Jean Kinck, this well-known chemist says—All the viscera, except the stomach and duodenum, are in full state of putrefaction; the internal parietes of the stomach exhibit a slaty colour, which had not penetrated into the tissue of the organ itself. On more minute examination being made, it was found that there were two distinct colours—one black, due to sulphuret of iron, and one blue, distinctly due to Prussian blue; the latter was detected with certainty, and this was sufficient evidence of the previous presence of hydrocyanic acid. The liquids of the stomach contained, moreover, a very large proportion of an alkaline sulphate, and in such large quantity as it never otherwise occurs in that organ. The Professor accounts for the presence of the three substances named by the rudimentary mode employed by Troppmann for the manufacture of hydrocyanic acid. That method is described as follows:—The convict used two retorts—one smaller, the other larger—the latter serving as receiving condenser. He used ferrocyanide of potassium and dilute sulphuric acid to prepare the hydrocyanic acid from, but was unable to prevent the formation of incrustations of sulphate of potassa and sulphate of iron; hence, irregularity ensued in the boiling of the liquid, and, along with the hydrocyanic acid, sulphate of potassa and sulphate of iron spirted over. In addition to these impurities, there was formed a white substance, which turns blue on exposure to air; and that substance has also been found in the stomach. Some of the Prussian blue found in Kinck's stomach was handed round to the jury at the trial.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Journal für Praktische Chemie, No. 15, 1869.

This number contains the following original papers:—

Some of the Substances met with in the Leaves and Bark of the Cerasus Acida.—Dr. Rochleder.—In a lengthy memoir, we find the enumeration of a lengthy series of substances partly met with in the leaves, and more especially in the bark, of the tree alluded to. The leaves contain amygdaline, some citric acid, quercitine, and a substance, $C_{31}H_{20}O_9$; the bark contains—phlobaphen, fuscophlobaphen, æscylic acid, rubrophlobaphen, a peculiar tannin, isophloroglucine, and isocaffeic acid.

Cane Sugar in Madder-Root.—M. Stein.—The author states that the existence of cane sugar in madder-root has not been hitherto proved. This statement is, however, erroneous, since even about the latter end of the last century attention has been directed to the fact that madder-root, and especially the Zealand madder, is rich in cane sugar, containing between 14 and 16 per cent. The extraction of this sugar, without interfering with the tinctorial value of madder, and by means different from those whereby that sugar is now utilised—viz., fermentation, and making of alcohol—is not elucidated, only discussed, in this paper. Since some 10,000,000 kilos. of madder are, at the very lowest estimate, consumed annually, and since the bulk of the sugar therein contained is utterly lost, there is a fair field of profitable experimental research still left open and untouched.

Fermentation Induced by the Microzyma of the Liver.—M. Kolbe.—320 c.c. of absolute alcohol, 40 grms. of freshly-cut-up sheep's liver, and 16 litres of water, were left standing for five months. The fluid was found to exhibit a very acid reaction, and to give off the odour of sweat. After filtration, the fluid was submitted to distillation, the retort being placed in a chloride of calcium bath, the distillate neutralised with soda, and the alcohol, which had come over unchanged, removed by distillation; the residue, treated with sulphuric acid, yielded capronic and other fatty acids.

No. 16, 1869.

None of the papers of this number are original, and the contents have been abstracted by us already. The death of the chief editor has caused this deviation from the rule; but the publisher states that satisfactory arrangements are being made to obtain original communications.

Zeitschrift für Chemie von Beilstein, No. 1, 1870.

This number contains the following original papers:—

Behaviour of the Flesh-Coloured Sulphide of Manganese with Various Reagents and at Variable Conditions of Temperature and Pressure.—M. Muck.—The sulphide of manganese alluded to was submitted, in sealed tubes at from 140° to 150°, to the action of water, sulphuretted hydrogen, hydrosulphuret of ammonium, polysulphide of potassium, ammonia, and caustic potassa solution. No very perceptible reaction was seen with water, sulphuretted hydrogen, and ammonia; with sulphide of potassium, the bulk of the manganese sulphide was left unaltered, but a small portion of the tube was coated with a very firmly-adhering violet precipitate; hydrosulphuret of ammonium caused complete conversion into green sulphide; with caustic potassa, the sulphide of manganese was converted into greyish white hydrated protoxide of the metal.

Action of Hydrochloric Acid upon Nitrobenzol.—Dr. Baumhauer.—When concentrated hydrochloric acid and nitrobenzol are heated in sealed tubes to 245° (the tubes often explode), there is found in the tube, after cooling, a crystalline substance, which, on being treated with boiling water, yields hydrochlorate of dichloraniline, some hydrochlorate of aniline, an oily substance difficult to purify, and a solid crystalline matter the nature of which could not be further determined; so that, *summa summarum*, this reaction is, in the main features, similar to the action, under the same conditions, of hydriodic and hydrobromic acids, with this difference—that the temperatures for the two last-named are, respectively, 104° and 185°.

Contributions from the Chemical Laboratory at Griefswald.—M. Otto.—A series of papers with the following headings:—On mercuro-diphenyl (a monograph on this subject). Mercuro-ditolyl—

$$C_6H_4\begin{matrix}CH_3\\Hg\end{matrix}C_6H_4\begin{matrix}\\CH_3\end{matrix}$$

a solid substance, insoluble in water, difficultly soluble in alcohol, and rather more soluble in hot benzol, chloroform, and sulphide of carbon; it fuses at 235°. Mercuro-monotolyliodide, a solid substance, insoluble in water, difficultly soluble in alcohol, and fusing at 220°. Aceto-mercuro-monotolyl—

$$C_6H_4\begin{matrix}CH_3\\Hg\end{matrix}$$
$$C_2H_3O{-}O$$

a solid, crystallising in rhombic prisms, fusing at 153°, somewhat soluble in boiling water, but better soluble in alcohol and benzol. Behaviour of dibenzyl at a higher temperature (chiefly a series of formulæ). Conversion of this phenol (phenylsulphohydrate) into phenylsulphide. Mercuro-dinaphthyle. Aceto-mercuro-monomethyl and aceto-mercuro-monoethyl. Preparation of organic sulphur compounds by means of hyposulphite of soda.

Non-Volatile Acids of Croton Oil, and the Non-Existence among them of an Acid $C_4H_6O_2$.—M. Geuther.—A review of the author's labours as compared with those of others on this subject.

Conversion of Isobutyl-Alcohol into Tertiary Pseudobutyl-Alcohol.—Dr. Markownikoff.—The reactions are represented in the following manner:—

$$\underbrace{\begin{matrix}CH_2I\\|\\CH\\|\\CH_3CH_3\end{matrix}}_{\text{Isobutyl-alcohol.}} - HI = \underbrace{\begin{matrix}CH_2\\\|\\C\\|\\CH_3CH_3\end{matrix}}_{\text{Isobutylen.}}$$

$$\underbrace{\begin{matrix}CH_2\\\|\\C\\|\\CH_3CH_3\end{matrix}}_{\text{Tertiary Butyl-iodide.}} + HI = \underbrace{\begin{matrix}CH_3\\|\\CI\\|\\CH_3CH_3\end{matrix}}_{\text{Tertiary Butyl-iodide.}}$$

Azoxytoluide.—M. Petrieff.—After briefly stating that M. Jaworski calls azoxytoluide an oil-like substance, the author says—The substance prepared by me from azotoluide by the action of sodium-amalgam is a solid crystalline substance, fusing at 57°, and soluble in ether and alcohol. On being treated with sodium-amalgam, it yields hydrazotoluide.

Preparation of Aniline-Red without Arsenic.—M. Coupier.—The author has succeeded in obtaining fuchsine by the action of hydrochloric acid and iron, in small quantities, upon pure aniline and nitrotoluol, taking care to apply a suitable temperature. Commercial aniline and commercial nitrobenzol also yield the same result; and M. Schützenberger states that, having been requested to test the results of this reaction, he has found that the aniline-red obtained is identical with that ordinarily made, and declared it to be a salt of rosaniline. The yield is very fair, and somewhat larger than when arsenic is used.

Cosmos, January 8, 1870.

Platinum Light.—M. Schinz.—According to the author's experiments, platinum, made incandescent, and brought to bright white heat by means of the ignition of a mixture of hydrogen and carbonic oxide gases, yields a light which, in relation to good coal-gas, is as 1·24 to 1·0.

Origin of the Fatty Oil contained in Olives.—M. Harz.—According to the author's experiments, the results obtained in this investigation are:—The substances secreted in the fruit do not, at its first formation contain any fatty oil. Up to the time of ripening there exist in the fruit, in the state of membranes, undeveloped cells, which become the seat of secretion of the oil, and which membranes may be rendered visible by means of reagents; each of these rudimentary cells contains a very large number of extremely small cells, which, at the time of ripening of the fruit, are converted into fatty oil. The membrane just alluded to may be rendered visible by the successive application of a solution of aniline and chloroiodide of zinc, whereby the membrane of the cells which contain a fatty oil assume a beautiful blue colour.

Discovery of Coals in Algeria and Turkey.—According to a statement in the *Echo d'Oran*, it appears that there has been found, near Laghouat, an excellent and abundant seam of coal, near the spot where the ancient Romans worked manganese, iron, and zinc mines. As regards the last-named country, M. Höchstetter states that he has found coal near Kézoulik, under the carboniferous limestone on the southern slope of the Balkan mountains.

Observatory on Mount Ararat.—The Russian Government have resolved to establish an astronomical and meteorological observatory on this mountain, situated near Tiflis, in consequence of the excellent report given by M. Piazzi Smyth of the fitness of such high situations, deduced from his experience on the Pic de Teneriffe.

Discovery of an Ancient Silver Mine.—The recent earthquakes in Germany have caused the fall of a large mass of rocks situated between Heidelberg and Wiesloch, and in consequence thereof the works of a silver mine, worked by the ancient Romans, have been brought to light. There is no silver-ore of any importance left, but, instead, a very rich zinc ore is met with in large quantity, which was left untouched by the former workers.

Polytechnisches Journal von Dingler, first number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

Dioptrical Notices.—Dr. Pohl.

Estimation of Sulphur and Gypsum in Animal Charcoal.—M. Reichardt.—The main feature explained in this paper is, that animal charcoal may, and often does, contain considerable quantities of gypsum; but, besides this, sulphur, apparently in combination with carbon, in a similar manner as sulphur may be met with in coke. The estimation of the sulphate of lime is effected, either by boiling the material under investigation with pure hydrochloric acid, or repeatedly with a solution of pure carbonate of soda. The sulphur is estimated by fusion and ignition of the animal charcoal with pure nitrate of potassa, and in each case the sulphuric acid is estimated in the usual way.

On Jute.—Dr. Wiesner.

Second number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

On the Various Means of Saving Fuel in the Metallurgical and Technical Applications thereof.—M. Schinz.—The author discusses, in this memoir, the subject under the following heads:—Increase of the size of the furnaces; decrease of the conductibility of the same; complete combustion; previous heating of air, as well as of fuel; preparation of combustible gases without nitrogen being among the same; highest possible consumption of fuel in a given time; combustion, under increased pressure, of air.

Newest Shape of M. Wild's Polaristrobometer (Saccharimeter, Diabetometer).—M. Wild.—Description of a very ingeniously-contrived apparatus, illustrated by a series of engravings.

Gas for Heating Purposes.—Dr. Ziurek.—The author states that gas from the brown coal from Furstenwald, five miles from Berlin, will be made on the spot, and collected in Berlin in twelve gas-holders, each of a capacity of 750,000 cubic feet. The gas will be carried, as usual, in underground mains, and mainly applied for heating purposes. 100 parts of the gas (sp. gr., 0·5451) consist of:—Hydrogen, 42·36; oxide of carbon, 40·00; marsh gas, 11·37; nitrogen, 3·17; carbonic acid, 2·01; condensible hydrocarbons, 1·09. 3000 cubic feet of this gas have a heating power of one-third of a ton of best coals, and are equal to 1 ton of best Prussian brown coal. 1000 cubic feet of this gas will cost about 5d. in Berlin; and the equivalent value of the heating power of this gas, as compared with a ton of coals, will be 4s. 6d. The works have been made to supply 9,500,000,000 cubic feet of gas annually, or at the rate of 2½ millions of cubic feet daily.

Thymol, a New Disinfectant.—M. Paquet.—The author proposes the use of thymol, so-called thymianic acid, the stearopten of the essential oil from *Ptychotis ajowan*, an umbelliferous plant growing in India. In undiluted state, this substance is a caustic, and used in dentistry for the cauterisation of hollow teeth; its advantage in this aspect being that it has not an unpleasant taste, and, being very aromatic, does not affect the breath as carbolic acid does. Its aqueous solution is a strong antiseptic and possesses disinfectant properties in a very high degree.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 203, 1869.

This number contains the following original papers and communications relating to chemistry:—

Injurious Effects of Impure Alcohol upon Aniline Colours.—Dr. Tillmanns.—The author has examined several varieties of alcohol, and tested the effects upon aniline colours. The most sensitive among these, for impure alcohol, is aniline purple (phenyl-rosaniline). It appears that empyreumatic substances, aldehyde, the peculiar fusel oils due to the substances used in the manufacture of the alcohol—viz., grain (malted or raw), potatoes, the refuse of beet-root sugar manufacture—affect the aniline colours when dissolved in such alcohols and boiled therewith. The best test for the purity of an alcohol is to dissolve in it 1 per cent of perfectly pure caustic potassa, and to heat the solution; it should only acquire a bright yellow colour. Another test is to dissolve 1 part of the aniline purple alluded to in 50 parts of the alcohol to be tested, and to heat the fluid for some time. If, after half-an-hour's heating, no change is observed, the quality of the alcohol is good; but if the latter is not pure enough, the mixture soon becomes turbid, and assumes a red colour. Aldehyde is often present in alcohol, especially if it has been purified by means of charcoal.

Moniteur Scientifique, No. 313, January 1, 1870.

This number opens with a full and lengthy account of the proceedings taken by the Ministère Public of the Tribunal Correctionel de Paris *in re* the explosion of the 16th of June last on the Place de la Sorbonne, caused by picrate of potassa. From the scientific, as well as other evidence given about the danger of picrate of potassa (several artillery officers and the Director of the Pyrotechnic School at Toulon having been examined), it appears that the substance alluded to is, as might be expected, far less to be feared than gunpowder, gun-cotton, and salts of fulminic acid. The accused, M. Fontaine, was fully acquitted, in every respect, of the charges made against him of having caused manslaughter by imprudence.

Artificial Porphyry.—MM. Sepulchre and Ohresser.—It appears that the authors have perfectly succeeded in utilising the slag of the iron blast furnaces for the manufacture of paving-stones, which withstand a crushing weight of more than 400 kilos. per square centim., and have answered for the purpose of paving several streets at Brussels and Paris, and stood heavy traffic far better than even the celebrated Quenast stones. The streets paved with this material at Brussels have a heavy gradient.

Lignite from Vescovado, Province of Sienna, Italy.—M. Kopp.—At only eight metres under the surface of the soil, is found a layer of lignite of 3·5 metres thickness. This substance, having been submitted to analysis, yielded, on being dried at 115°, 21·80 per cent of water. On being calcined in a closed crucible, 100 parts gave:—Volatile combustible matter, 26·48; fixed carbon, 42·52; ash, 9·20; water, 21·80. When submitted to dry distillation in a gas retort, acetic acid is among the products, and 51 per cent of coke; the quantity of sulphur amounts to 1·36 per cent. 1 kilo. of lignite is capable, on combustion, of evaporating 6·1 litres of water. Since there is no coal found in any part of Italy, as far, at least, as it has been explored, this material is of considerable value to the industry of that country.

Artificial Alizarine.—MM. Meister and Lucius.—These gentlemen write to the editor of the above-named periodical in reference to what was stated about their invention, and abstracted by us (see CHEMICAL NEWS, vol. xx., p. 299), and, denying the truth and correctness of what is there given, now explain that they legally deposited the secret of their mode of manufacture with the Burgomaster of Hoechst (Prussia), and that, consequently, legal proof can be given, both as to their peculiar process and as regards priority. They also state that the first samples made were not quite satisfactory, but that now they are in full swing, and have such an increased demand for their produce as to render it impossible for them to serve their customers immediately, they having to wait till their turn comes.

Detection of Fixed Fatty Oils obtained from the Seeds of Cruciferæ.—M. Gréhaut.—Some fatty oils, especially those obtained from the *Cruciferæ* (colza, rape, cameline, mustard), naturally contain sulphur. This may serve for the detection of these oils by boiling

some 25 grms. of the same with an aqueous solution of 2 grms. of caustic potassa in 20 grms. of water. When the mixture is poured on to a previously-moistened filter, the filtrate will blacken paper soaked in acetate of lead or nitrate of silver; and, on addition of some hydrochloric or sulphuric acids, sulphuretted hydrogen is given off, easily recognised by the smell. Linseed, nut, sesame, or ground-nut oils, do not contain sulphur, and do not, consequently, give rise to this phenomenon, if treated in the same manner. The experiment is best performed in a clean bright silver capsule, which, of course, becomes at once brown- or black-coloured, owing to the formation of sulphide of silver in a more or less degree.

Revue Hebdomadaire de Chimie, January 6, 1870.

Manufacture of Soda by the Use of Strontia and Ammonia.—M. Ungerer.—When, to a concentrated solution of sulphate of ammonia, is added an equivalent quantity of chloride of sodium, and the fluid heated to boiling-point, mutual decomposition of these salts takes place, and sulphate of soda and chloride of ammonium is formed; the former salt separates as a crystalline powder, and may be removed by filtration from the solution of the chloride of ammonium. The sulphate of soda, having been dissolved in water, may be decomposed by caustic strontia, thus yielding caustic soda; the chloride of ammonium may be converted into carbonate of ammonia by means of chalk. It is doubtful whether this process, theoretically correct, will be commercially available.

Bleaching of Fixed Fatty Oils.—M. Diéterich.—Into a wooden tub, provided with a properly-constructed tap at the bottom, are poured 30 litres of water, wherein 1 kilo. of permanganate of potassa is dissolved. To this mixture is added 50 litres of the oil to be bleached, and the fluids well stirred up for about two days; at the end of that time, 20 litres of boiling water and 5 kilos. of commercial hydrochloric acid are added; the liquid is again well stirred up; and, after two more days, the acid liquor is run off by means of the tap, and, having been removed, the oil is repeatedly washed with boiling water, until all the acid is removed from it.

Beer-Yeast as a Manure.—M. Bernier.—Beer-yeast contains from 7 to 11 per cent of nitrogen; it is easily decomposed—in common parlance, soon rotten. The author mixes 100 kilos. of it with 30 kilos. of slaked lime and 10 kilos. of gypsum, and thus obtains a pulverulent substance, which may be applied in agriculture instead of guano. It is well-known that, especially in summer, large quantities of this yeast are run off into sewers and altogether wasted.

Les Mondes, January 6, 1870.

This number contains the following original paper :—

Instantaneous Production of Artificial Precious Stones.—M. Zchweskofski.—Many of our readers have seen that the ordinary newspapers have communicated some more or less sensational accounts concerning the instantaneous artificial preparation of precious stones. It appears that the author has discovered some peculiar silicic and aluminous ethers; but it is not true that these yield, on evaporation, precious stones, and certainly no diamonds, as reported by some newspapers, whose editors do not seem to know what diamonds are. Altogether, the communication (excepting the discovery of the ethers above alluded to) is a *canard*.

January 13, 1870.

Aurora Borealis Seen at Nantes.—L'Abbé Trébeden writes, that on the 3rd inst., at ¼ past 6 p.m. (local time) he observed a brilliant aurora borealis which occupied an arc of 70° of the horizon, and extended some 20° in height. The temperature of the air was at that moment 7·1°, and the reading of the barometer 768 m.m. The phenomenon lasted fully an hour, perhaps longer; but it became invisible on account of clouds coming up. The city of Nantes is situated about 46° N. latitude.

On the Nascent State.—M. St. Claire-Deville.—This paper is the first of a series which the author intends to publish in this periodical on a subject which cannot be well rendered in extract. We intend to return to this subject.

Influence of the Phases of the Moon upon the Height of the Barometer.—M. Coloria.—The result arrived at is that there does not exist any definite relation between the height of the barometer and the synodic revolutions of the moon.

Action of Tobacco and Effects of Smoking upon the System.—Dr. Sée.

NOTES AND QUERIES.

Detection of Opium in Tobacco.—(Reply to E. Morton.)—Make an infusion of the cigars in water slightly acidulated with acetic acid. Filter, and add basic acetate of lead till all the colouring matter is nearly precipitated; again filter and digest during a whole day with a little animal charcoal. Collect the charcoal, and boil it in alcohol twice or three times, using altogether about a pint of that solvent. Evaporate this solution to dryness on a water-bath, and treat the extract, first with water rendered freely alkaline by ammonia, then with ether, and lastly with alcohol; this is now evaporated, and the residue tested for morphia as usual. 0·02 grms. of opium may be detected by this process in a single cigar.—John Muter, Ph.D.

Detection of Opium in Tobacco.—(Reply to E. Morton.)—Although it is hardly likely ever to occur that tobacco should be adulterated with opium, the latter substance might be detected by the reactions of meconic acid. Opium does not burn well at all; neither does the *tandoo* (*i.e.*, its aqueous and inspissated extract) do so, for it is a well-known fact that opium smokers can only keep the small quantity they use alight by means of the aid of a spirit-lamp, or by means of an addition of some easily-burning substance to the extract. Moreover, opium is too expensive a drug to adulterate tobacco with, and those who use opium (as, unfortunately, too many do in this country) employ it in a pure state.

Fancy Colouring of Metals.—The colouring matter of small objects in metal has recently occupied the attention of manufacturers and chemists, and M. Pushec, a German chemist, gives the following recipes for the application of sulphur to the purposes referred to:—(1) A solution is made in the following manner:—Dissolve 4 ozs. of the hyposulphite of soda in 1¼ pints of water, and then add a solution of 1 oz. of acetate of lead in the same quantity of water. Articles to be coloured are placed in the mixture, which is then gradually heated to boiling-point. The effect of this solution is to give iron the effect of blue steel; zinc becomes bronze; and copper or brass becomes successively yellowish, red, scarlet, deep blue, light blue, bluish white, and, finally, white, with a tinge of rose. This solution has no effect on lead or tin.—(2) By replacing the acetate of lead in the solution by sulphate of copper, brass becomes first of a fine rosy tint, then green, and finally of an iridescent brown colour. Zinc does not colour in this solution—it throws down a precipitate of brown sulphuret of copper; but if boiled in a solution containing both lead and copper, it becomes covered with a black adherent crust, which may be improved by a thin coating of wax.—(3) If the lead solution be thickened with a little gum tragacanth, and patterns be traced with it on brass, which is afterwards heated to 212°, and then plunged in solution No. 1, a good marked effect is produced.

MEETINGS FOR THE WEEK.

Monday, 24th.—Medical, 8.
—— Geographical, 8.30.
—— London Institution, 4.
Tuesday, 25th.—Royal Institution, 3. Prof. Humphry, "On the Architecture of the Human Body."
—— Institution of Civil Engineers, 8
—— Ethnological, 8.
Wednesday, 26th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 27th.—Royal Institution, 3. Prof. Odling, "On the Chemistry of Vegetable Products."
—— London Institution, 7.30.
—— Royal, 8.30
—— Zoological, 8.30.
Friday, 28th.—Royal Institution, 8. Prof. Odling, "Graham's Scientific Work."
—— Quekett Club, 8.
Saturday, 22nd.—Royal Institution, 3. Mr. Scott, "On Meteorology."

TO CORRESPONDENTS.

*** Vol. XX. of The Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

R. Reynolds.—Received, with thanks.

A. Hedley.—Dr. Lunge, of South Shields, will be able to give you full information about the use of aluminate of soda in soap making.

J. Watkins.—To prepare hydrochlorate of aniline and tartrate of aniline you must saturate aqueous solutions of the respective acids with aniline.

C. P. Bahin and others.—You will see the explanation on the front page of the present number.

J. T. Thompson.—A work by Dr. Letheby, "On Food," is just published by Messrs. Longmans.

Prof. J. Laurence Smith (Louisville).—Your letter and enclosure have been received, and shall be attended to. The Photometer invented by the Editor is manufactured by Messrs. Elliott and Co., of Charing Cross, London.

BOOKS RECEIVED.

Rinderpest: its Prevention and Cure, and Gypsum as a Sanitary Agent. Edinburgh: William P. Nimmo. London: Simpkin and Co.

On the Ozonometer for the Observation of Ozone with an Aspirator; Instructions for its Use, and the Results obtained. By John Smyth, jun., M.A., F.M.S., &c. (From the Author.)

THE CHEMICAL NEWS.

Vol. XXI. No. 531.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 26.)

VII. M. Gaston Tissandier's Method of Analysing Animal Black.

When the author of these notes penned that immediately preceding this, he little thought that it was at all necessary to go into the details of the process of analysis, but contented himself by simply throwing out a hint or two upon the subject; the simultaneous appearance of M. G. Tissandier's notes upon animal black with his own has, however, shown him his mistake. The methods recommended by that gentleman are so faulty as to demand some special remark.

1. *The Carbon.*—M. G. Tissandier arrives at the proportion of this most important agent by a method which cannot be relied upon. The writer at one time thought that he had made a great time-saving discovery, when the idea of doing as M. G. Tissandier recommends struck him, but he soon found out his mistake: the difference between the "ash" and the original weight *does not* give the carbon and moisture. To whatever cause it may be due, the results obtained by this process always differ from those obtained by the more trustworthy method hereafter to be described. Two objections to M. G. Tissandier's process may be pointed out—There is always iron present in animal black, and, as indicated in the preceding note, it always exists as protoxide; this is, of course, peroxidised by M. G. Tissandier's process. The carbonates are liable to decomposition, and though caution, during the process of calcination, is recommended, the manipulator has no guarantee that he has not decomposed a portion of them; and to moisten with ammonium carbonate, as recommended by Dr. Wallace, is not at all safe. The analysis should always be made upon the dried sample—the moisture may, of course, be estimated in the usual way, in a portion (several hundred grains) of the original *unground* sample; but, with working chars, unless the sample is for sale, the moisture may be left out altogether. It may be necessary to state, as a reason for estimating the moisture in the original char in preference to the pulverised, that in the process of grinding, which occupies some time, the char, if comparatively dry, is liable to absorb moisture from the atmosphere. 50 grs. of the sample, in impalpable powder (which *should not* be sifted, but the whole reduced uniformly to the necessary fineness, the hard gritty grains which so persistently resist the action of the mortar and pestle sometimes, have usually a different composition from the softer portions, and ought not to be rejected, as M. G. Tissandier recommends), are boiled in dilute hydric chloride; twenty minutes are usually necessary to accomplish this satisfactorily. The insoluble is thrown upon a weighed filter, and very thoroughly washed; the filter, after drying, is weighed—the difference being carbon and sand. The drying and weighing must be very carefully attended to; after the first weighing, the filter should be returned to the drying oven, and after a time weighed again, and so on until the results are constant. The filter is then ignited, the residue being sand and clay; the weight of this, deducted from the previous result, will, of course, give the carbon, and that accurately. The carbon being a most, if not the most, important element in the char, its accurate determination must be made a point in the analysis.

2. *The Silica* by M. G. Tissandier's process will be found much too high; "water acidulated with chlorhydric acid," "slightly heated," will scarcely have the desired effect upon ignited "ash." The twenty minutes' boiling with moderately strong acid, referred to above, will be no more than competent to do the work indicated, but from the preceding remarks it will be seen that the sand, &c., can be got at otherwise.

3. *The Phosphates.*—It seems passing strange that the system of precipitation by ammonia should again require to be publicly protested against. The results by this process are worth nothing; and how, otherwise than by accident, an analysis can be got to come to 100 when it has been employed the writer cannot guess. Perhaps if M. G. Tissandier had been asked to reconcile the phosphate results of different analysts (as the writer has been), he would long ere this have consigned the process to oblivion. Better leave the phosphates alone altogether than precipitate them by ammonia; the analysis will more likely be correct. Precipitation as ammonio-magnesian phosphate will, with care, give reasonably-accurate results.

4. *The Carbonates* must not depend upon the lime left over in the solution after the separation of the phosphates: many errors creep in here. The total lime should be estimated by precipitating with oxalate of ammonia, as a check upon the other results; but the carbonic acid itself must be the guide to the amount of carbonates. One process for carbonic acid has already been referred to with favour. In the absence of Dr. Schiebler's apparatus, however, some of the usual gravimetric methods admitting of the use of hydric chloride may be employed.

5. M. G. Tissandier makes no mention of iron in his analysis. He may be dealing all alone with new, unused char, in which the iron is usually very trifling; but he does not say so. The iron is an essential point in the analysis of used chars, and is not to be passed lightly over even in new, unused chars. As already indicated, its estimation may be accurately made by Penny's process. The strength of the bichromate solution best adapted for the delicate operation is 2·75 grs. of the pure and dry salt to 1000 grs. of water; in which case the alkalimetric measures consumed will be divided by 16 to give percentage of metallic iron—*i.e.*, supposing 100 grs. of the char to have been used. The process must be conducted neatly and rapidly, as the solution is liable to absorb oxygen from the atmosphere.

M. G. Tissandier concludes this part of his paper by appending the results of the analysis of three samples of char. The writer has seen and executed several hundred analyses of this agent, and never, in all his experience, has he met with more extraordinary results than those given by M. G. Tissandier, as illustrative of the composition of this substance (?). Are these the analyses of new chars, or old? Have they been used in the "beet" manufacture, or in connection with some special process? Where is the iron, and the sulphates? For what object are the results published? Without some information upon these points, they can only mislead the reader.

M. G. Tissandier's method of estimating the decolourative power of chars is very pretty, but of no practical value. The results will express *the relative power of pulverised animal-black to decolourise caramel*; but that is not what the sugar refiner requires. For sugar-refining purposes, nothing but sugar-refining methods of testing decolourative powers will do. The author has tried many devices, both with grain and pulverised char, with logwood decoction, caramel, &c.; but the results in no case give the true value of the char to the refiner. The directions given in Note V. have been followed, with the most satisfactory results, for three years. During that time, several other *simpler* systems have been tried; but all have had to give way to the *more tedious, but accurate*, system described.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 31).

INTIMATELY connected with microscopical drawing is the subject of micrometry, the practice of the two together forming the records and statistics of histological science. The contrivances used by the earlier observers were rude in the extreme. Leeuwenhoek compares the dimensions of magnified objects with grains of sand. Dr. Hooke, with a little more approach to exactness, used fine silver-wire. By winding a quantity of this closely round a thicker wire, he noticed how many coils there were in an inch, and used the unit so obtained as a means of measurement. The most perfect of the old micrometers is a somewhat complicated contrivance attached to a microscope by the famous Benjamin Martin, now in the possession of the Royal Microscopical Society. It consists of a separate stage, which is placed on the instrument when measurements are required to be taken. The object is capable of being moved through a definite space, by means of delicate screws, having large graduated heads, upon which the distance traversed by the object can be read off. This micrometer has, in common with all measuring instruments applied to the stage, the defect that any error in the graduation is multiplied by the whole magnifying power of the instrument.

The standards employed in microscopic measurements are the ruled slips of glass before mentioned. They are graduated by a machine invented by the late George Jackson, and are now to be obtained of most opticians. They are ruled in hundredths and thousandths of an inch, and are marvellously accurate in their divisions, and extremely fine in the engraving of the lines, bearing a very high magnifying power without appearing coarse. Scales are also ruled in millimetres. The millimetre equals 0·03937 English inches, or about 1-25th of an inch. As the metric system will probably in a few years be universally adopted, it is well to place both scales on microscopical drawings, especially as this system of measurement is common on the Continent.

One method of measurement has already been mentioned in describing the use of the camera lucida.

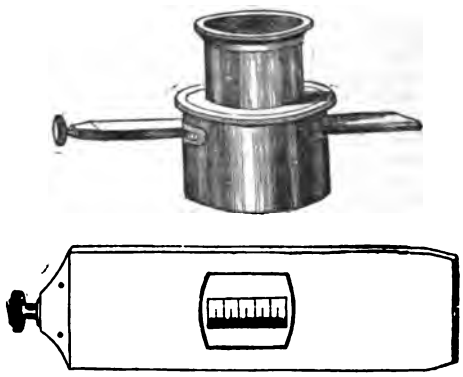
To obtain the greatest degree of accuracy in microscopical measurements, it is desirable that, while the object to be measured is magnified as much as possible, the measuring scale should be but slightly enlarged. This is effected by the use of eye-piece micrometers. The most delicate of these is the well-known *cobweb micrometer* of Ramsden. It is nearly similar to that employed in astronomical instruments, and consists of a positive or Ramsden's eye-piece, in the focus of which is placed a pair of stretched cobweb-lines, one of which is fixed, and the other movable by means of a fine screw which has a large graduated head. The value of the graduations has to be determined for each object-glass, as is the case with all similar contrivances. The cobweb micrometer, when used with a sufficiently high power, is capable of measuring extremely small portions of space with great exactness; the instrument, however, is rather expensive.

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

With a view to avoid the multiplication of apparatus, the late George Jackson, by a simple contrivance, rendered the ordinary Huyghenian eye-piece available for micrometric purposes. A slit was cut on each side just above the diaphragm (Fig. 43 A), which served to admit a brass slide, B, containing a scale ruled on glass, which, when in position, was in the focus of the eye-glass, and could be seen in the field at the same time with the object in the microscope. The scale is ruled with a long line at every fifth division, and a still longer one at every tenth, for facility of reading. The scale is allowed a small amount of lateral motion, which is controlled by a fine screw acting against a spring on the opposite

FIG. 43.

A



B

side. This movement enables the line from which the measurement commences to be brought to the edge of the object more accurately than it could be by means of the stage movements, as the scale of the eye-piece micrometer is only magnified by the trifling power of the eye-glass, while the motion of the stage-racks is enlarged by the whole power of the instrument. The operation of measuring is nearly as easy as applying an ordinary rule: the scale is brought over the object, adjusted by the screw, and the number of degrees read off in the direction required.

To determine the value of the degrees, which differs with each objective, the following process must be adopted:—

Place the micrometer in its eye-piece, and focus, if necessary, for distinct vision of the scale by unscrewing the eye-glass, which is usually provided with a rather long screw for this purpose. Screw on the objective, and place the ruled scale on the stage; and, looking through the microscope, focus until the lines are sharp and distinct. Suppose the value of the micrometer is to be ascertained for the ⅛ object-glass, and it is found that 1-1000th of an inch of the ruled scale on the stage occupies a little less than two divisions of the micrometer, this will give an awkward number for calculation; so it will be necessary to increase the power of the microscope to such an extent that the 1-1000th should occupy 2° exactly. This can be done by lengthening the body by means of the draw-tube, which, for this purpose, should be divided into inches and tenths, that the amount of extension may be noted. The tube is to be drawn out until the divisions of the stage micrometer coincide

with those of the eye-piece micrometer. Say, for example, it is found that, to effect this, the tube has to be lengthened 3-10ths of an inch; then, as 1-1000th of an inch equals 2° of the eye-piece micrometer, 1° is equal to 1-2000th of an inch. This process should be repeated with each object-glass, and tried several times, to ensure accuracy. The result should be preserved in the following tabular form:—

VALUE OF DIVISIONS OF EYE-PIECE MICROMETER.

Objective.	Draw-tube.	Vulgar Fraction.	Decimal.
1½	13	1/1000	·001
¾	3	1/2000	·0005
4/10	22	1/4000	·00025

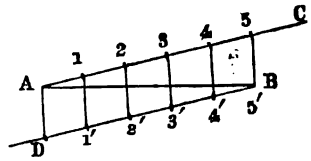
And so on through the whole series of objectives. The slight alteration of distance between the anterior combination and the back lenses caused by turning the graduated collar which regulates the adjustment for covering glass with the higher powers, slightly alters the magnifying power; and, when very accurate measurements are required, the draw-tube correction must be ascertained for each degree of the adjustment-collar. The value of the divisions of the Ramsden's or cobweb micrometer is calculated in the same manner. When this table is once made, measurement with the eye-piece micrometer becomes very easy indeed. After selecting the object-glass and placing the micrometer in the eye-piece, draw out the tube. The number of tenths indicated in the table, and then the degrees, can be read off just like an ordinary measure. To secure accuracy in measuring, always use the highest convenient magnifying power, as the readings can be made with greater minuteness; for instance, a degree with the 4-10th or ⅖ equals 1-4000th of an inch; while, with the ⅛, it would be 1-16000th, and half a degree can easily be estimated by the eye; so, by using the higher power, the 1-32000th of an inch can easily be measured, and greater minuteness still can be obtained by using higher powers, where practicable.

A convenient mode of measurement has been devised by Dr. J. Matthews. It is an adaptation of the indicator, sometimes placed in the eye-piece to mark a spot in the field. Two of these pointing needles, suitably curved so that they act, by means of milled-heads, like a small pair of callipers, are placed as just mentioned. The distance on the object is measured between these points, and, upon the removal of the slide, the value of the space can be estimated by putting the stage micrometer in its place. For counting striæ and other marks in a given space, and for many purposes, this simple contrivance is very effective, as, also, where the glass of the stage micrometer might interfere with the definition of a very delicate object.

In making the scales on microscopical drawings, it is often necessary to divide a given space into a certain number of equal parts. When the number is a multiple of two, it is readily performed by a continued process of bisection; but, as ten is a number frequently required, this process will not serve beyond the first bisection, which leaves five—a rather troublesome number to guess at with the compasses. Suppose the line A, B (Fig. 44) is to be divided into five parts. From A, rule the line A, C at any convenient angle, of any suitable length; from B, rule B, D parallel to A, C; from A, set off, with the compasses, five equal spaces (1, 2, &c.) towards C; and, from B, set off the same towards D; join 1, 1'; 2, 2'; 3, 3'; &c.; and the lines 1, 1', &c., will divide A, B into five equal parts. Any number of divisions may be made by setting off the number required on A, C and B, D.

If scales are employed for setting off distances, those known as "feather-edged scales" are to be preferred, as they do not require the use of compasses, the divisions being marked directly on the

FIG. 44.



paper from the thin edges. For general purposes, that known as a builder's scale is convenient, as it contains a large number of different scales, all of which are ingeniously contrived to read at the edges. It should, however, have the sub-divisions in tenths, and not, as usually made, in twelfths. A millimetre scale will also be found useful.

(To be continued.)

NEW METHOD FOR THE SEPARATION OF THE PLATINUM METALS*.

By Professor BUNSEN.

IN the metallurgic process of extracting platinum from its ores, there are obtained three products, which are admirably adapted for obtaining those rare metals which constantly accompany this metal. These products are:—

1. The "Ore residues," which remain behind after the mass of platinum, &c., has been extracted by aqua regia; these are rich in osmium and iridium, hence best adapted to the purpose of extracting these metals.

2. "Osmiridium," obtained, by mechanical washing, from the first residue, and which is best adapted for obtaining ruthenium.

3. The "Mother-Liquid Residues," left behind in the aqua regia solutions after reduction with iron, the platinum having previously been separated (with chloride of potassium ?). These are rich in palladium and rhodium, and are the best for obtaining these metals.

The following researches were made with a material of the last sort; for each separation, 1 kilo. of residue was used.

The residue contains, with the exception of osmium, all the platinum metals, and is particularly interesting on account of its relatively great richness in rhodium.

Claus's mode of separation (the only one previous to this) involves the loss of much valuable material. To separate the rhodium from iridium, Claus used the old method proposed by Wollaston, which depends upon the solubility of the ammonium (or potassium) double salt of sesquichloride of rhodium in chloride of ammonium. The fact, however, that the salt $KCl,IrCl_2$, is taken up in considerable quantity by a solution of chloride of ammonium (or chloride of potassium) saturated with a rhodium double salt, a fact of which I have repeatedly convinced myself, is sufficient to awake the gravest doubts as to whether the metal given out to be rhodium, and to which Berzelius and Claus ascribed the atomic weight = 52, did not contain considerable quantities of iridium. I found it, there-

* Translated from his late contribution to the *Annalen der Chemie und Pharmacie*, entitled "Ueber das Rhodium," by W. H. Wahl. Communicated by Professor Morton, editor of the *Journal of the Franklin Institute*.

fore, necessary to leave the beaten track, and to search for a more exact method of separation.

Separation of Platinum and Palladium from the other Metals of the Group.

The complete separation of rhodium, iridium, and ruthenium from platinum and palladium, by digestion with aqua regia, will not succeed with these questionable residues, as considerable quantities of the first-named metals are present in the form of hydrated sesquioxides, and partly present in a most finely-divided state, and in consequence, dissolve with the platinum and palladium; without taking into consideration the fact that the residue left behind by this digestion is only filtered with infinite difficulty.

On the other hand, it is easy to effect the separation of platinum and palladium from the others, almost completely, if the original material is mixed in a Hessian crucible with from ½ to ¾ its weight of chloride of ammonium, heated until the latter is completely volatilised, allowed to glow gently until only the vapours of sesquichloride of iron show themselves, and then placed in a porcelain dish and evaporated to a syrupy consistency with from two to three times its weight of raw *commercial* nitric acid. By this treatment with chloride of ammonium, the metals present not belonging to the platinum group will have been partially converted to *lower chlorides;* rhodium, iridium, and ruthenium will have been rendered insoluble, and the silica, present as gangue, converted from a gelatinous mass to a finely-pulverulent condition, in which state it will admit of speedy filtering.

The chlorine compounds, produced by the chloride of ammonium, give us, upon digestion with nitric acid, just enough hydrochloric acid to dissolve the platinum to bichloride, while the metallic copper and iron present act in so far reducing upon the palladium (in solution in nitric acid) that it remains in solution, not as bichloride ($PdCl_2$), but as the protochloride (PdCl), which latter is not precipitated with chloride of potassium. The mass is diluted with water, filtered, and the solution saturated with chloride of potassium, and the greater part of the platinum separated pure as $KCl,PtCl_2$, which is washed out, first with chloride of potassium, and later with absolute alcohol (the last washings must not be added to the solution). This precipitate weighed 62 grms.

The filtrate is brought into a large flask (which can be made air-tight) which will not be more than half-filled with it. Chlorine gas is led into this flask, and the same is, from time to time, shaken vigorously until no further absorption of gas takes place, when all the palladium will have separated as a cinnabar-red precipitate of $KCl,PdCl_2$ (somewhat impure, however, from traces of platinum, iridium, and rhodium). This precipitate weighed 157 grms. The fluid from which these precipitates were obtained is now evaporated, not quite to dryness, with hydrochloric acid; and, upon addition of *just so much water as was necessary* to dissolve out the chloride of potassium and other soluble salts (aiding the operation by rubbing with a pestle), there remained behind a dirty, yellow-coloured precipitate. This was separated by filtration, boiled with caustic soda and a few drops of absolute alcohol. Hydrochloric acid was added to dissolve the precipitate formed, and the liquid then saturated with chloride of potassium. result was a precipitate of 13·5 grms. of chemically-pure $KCl,PtCl_2$. The mother liquid contained only copper, and no platinum metals.

The purification of the cinnabar-red precipitate of palladium was accomplished as follows:—It was dissolved in boiling water, whereby a portion of the chloride dissolves, with evolution of chlorine, to PdCl. It was then evaporated with 60 grms. of oxalic acid, and dissolved again in a solution of chloride of potassium; whereupon 42 grms. of $KClPtCl_2$ remained behind, which, upon testing, proved chemically pure. It was washed out as before.

The brown liquid was then somewhat concentrated upon the water-bath; and, upon cooling, there separated 19 grms. of bright green, well-formed crystals of KCl,PdCl (with some chloride of potassium), which, upon testing, likewise proved free from the other platinum metals.

The fluid poured off from these crystals was then neutralised carefully with caustic soda, and gave a very slight precipitate of copper and iron, which was filtered off. Upon adding iodide of potassium to the filtrate, all the palladium separated as PdI. To avoid adding an excess of the reagent, it is best to take, from time to time, a drop from the fluid with a capillary tube, and bring the same upon a watch-glass. As long as the precipitation is incomplete, the drop appears, upon a white background, *brown;* when complete, it is *colourless;* when the reagent is present in excess, it is *red*. This weighed 77 grms., and was tested for its purity by reducing it to metallic palladium, and then heating and dissolving in nitric acid; when pure, it must dissolve completely. The whole mass was now reduced in a slow stream of hydrogen gas (whereby the iodine can be obtained again, as hydriodic acid, by absorbing with water). At last, the mass must be strongly heated, to decompose slight traces of the subiodide of palladium (Pd_2I) which are formed.

The mother liquid from which all this platinum and palladium has been obtained may contain some iridium and rhodium; it is, therefore, evaporated to dryness with a little iodide of potassium, whereby a mixture of the iodides of rhodium and iridium separates. This can either be dissolved in aqua regia and the two metals separated (as will hereafter be described) by the bisulphite of soda, or it can be united with the portion from which these metals will be obtained.

Separation of Ruthenium, and of Rhodium and Iridium.

The residue from 1 kilo. of the original material which remained, after treatment with chloride of ammonium and nitric acid, weighed 400 grms. It was treated as follows, to get the metals in a form adapted to further chemical treatment.

The method depends upon the behaviour of chloride of zinc to zinc. If a piece of zinc be smelted, it rapidly covers itself with a stratum of oxide. If, to the smelted metal, a metal like iridium be added, the oxide stratum hinders the latter from coming into contact with the zinc, even though it be pushed beneath the surface. If, however, a few grains of chloride of ammonium be given to it, ammonia, hydrogen, and chloride of zinc will be formed, which last dissolves the oxide stratum to basic chloride of zinc. The zinc below resembles mercury in lustre and movability. As soon as the chloride has dissolved as much of the oxide as is possible for it, the oxide stratum again forms, and is instantly removed again by the addition of more chloride of ammonium. The melted zinc, strewn with chloride of ammonium, also possesses, like mercury, the property of attacking other metals, if the affinity exists of forming with them alloys. By strewing chloride of ammonium upon the melted zinc, a quiet surging is kept up as the ammonia and hydrogen are given off. Many oxides and chlorides (among which are those of the platinum metals) are, when they come into contact with this atmosphere of reducing gases, and with the basic chloride of zinc, instantly reduced and dissolved to alloys by the zinc. [We have here a means of separating quantitatively all metals which are not dissolved by zinc from those which are.] In making the solution, the zinc, in a porcelain dish, should be constantly rotated: the gangue remains in the basic chloride. The regulus, immediately upon solidifying, should be taken from the capsule, out of the yet-fluid basic chloride, and washed off with acetic acid until all the basic chloride is dissolved away. The gangue can be quantitatively determined by filtration and weighing. If the regulus is not immediately removed, the containing vessel will be broken, owing to the unequal expansion of the porcelain and the metal.

The best proportions for a quantitative separation are, to 1 part of the expected platinum metals, from 20 to 30 parts of zinc. For an ordinary separation, 7 parts of zinc are sufficient.

For the extraction of the residues remaining after our treatment with nitric acid, this method is admirably adapted. By fusing only once with zinc for two or three hours, all the platinum metals are extracted. The operation is the following:—

From 3 to 3·5 kilos. of commercial zinc were fused in a 2-litre Hessian crucible; chloride of ammonium, from time to time, strewn upon it, the 400 grms. of residue, previously heated to faint glowing with chloride of ammonium were added, and the temperature kept, for two or three hours, just above the fusing point of the alloy, by adding, whenever the mass threatened to solidify, some chloride of ammonium. The mass is divided into three strata after solidification has taken place.

The *outer* stratum, easily broken away by a blow from a hammer, contains *no* platinum metals. The *next* contains some particles of the zinc and platinum alloy, imbedded in the basic chloride of zinc; it is porous, and not very thick.

The *inner* stratum consists of a frequently beautiful crystalline regulus. To obtain the alloy from the middle stratum, it is only necessary to wash repeatedly with water; and the alloy gained is, of course, to be added to the regulus. To obtain this regulus as pure as possible, it was again fused with 500 grms. of zinc and some chloride of ammonium, then granulated in water, and the granules dissolved in fuming hydrochloric acid. The acid attacks the regulus with the greatest energy, and the solution was completed in less than an hour. The chloride of zinc can be used for the next operation.

The platinum metals are found at the bottom of the vessel, in the form of a finely-divided black powder, which is impurified with zinc, and with traces of iron, copper, &c., from the latter. It cannot be purified with nitric acid, nor with aqua regia, for part of the platinum metals will thereby be dissolved, or, at best, so suspended in the fluid that filtration is impossible. If, however, the powder is treated with hydrochloric acid, singularly enough, all the impurities are dissolved; not only zinc and iron, *but also lead and copper, dissolve readily, with the generation of hydrogen*. The explanation is readily found in electrical currents produced by the contact of the metals, the stream passing from the positive zinc, iron, &c., to the negative platinum metals, hydrogen being given on the latter, and chlorine on the former, and uniting with them. The metals (rhodium, iridium, &c.), after thorough washing, weighed 65 grms. This powder possesses the property, upon being gently heated, of exploding weakly, and, when highly heated, with violence, the explosion being accompanied with the evolution of light; thereby neither hydrogen, nor chlorine, nor nitrogen, nor aqueous vapour are given off; and, as these are the only elements which it is possible that the metallic powder could have taken up, it must be assumed these metals are, by our treatment, converted into an allotropic condition, and that, upon heating, they return, with more of less energy, to their original condition. The powder contains, mainly, rhodium and iridium; but there are traces present of platinum, palladium, lead, copper, iron, and zinc.

It was intimately mixed with about three or four times its weight of completely anhydrous chloride of barium, and a stream of chlorine gas led over it at a tolerably high temperature. The operation is concluded when particles of sesquichloride of iron show themselves on the neck of the flasks containing the powder. It is carefully brushed away with filter-paper. Some water was now added, and the mass of the platinum metals dissolved with the evolution of heat. There remained behind 13·7 grms. of insoluble matter, which, upon reduction with hydrogen, alloying with zinc, and treatment with hydrochloric acid, furnished 4·5 grms. of ruthenium. From the original 65 grms. of metal-powder, there were dissolved, in three hours, and with the use of four ordinary burners, 57 grms. of the platinum metals; there being consumed thereby 415 grms. of 85 per cent black oxide of manganese. From this solution all the chloride of barium was removed by careful addition of sulphuric acid [see the precipitation of palladium]. The platinum metals were now completely freed from all other metals, by reduction with hydrogen [with 100 grms. of material, this operation will require five or six days], the temperature being, throughout the operation, maintained at nearly 100° C., by means of the constant water-bath. Platinum and palladium chiefly separate first; then mainly rhodium; and the last portions consist almost entirely of iridium. It is best to break off the operation when the fluid has assumed a greenish-yellow colour. The last portions of iridium (obtained by evaporating the solution to dryness, fusing with carbonate of soda, and treatment with aqua regia) were added to the portion, afterward to be again rendered workable by renewed treatment with chloride of barium. The operation of reduction is hastened by concentrating the fluid; in doing which care must be taken to guard against explosion, on account of the hydrogen. The separated metals were treated with aqua regia, and the platinum and palladium thus dissolved were separated from each other as above described. The traces of rhodium and iridium in the mother liquid can be removed entirely by continued boiling with iodide of potassium (whereby they precipitate as iodides) dissolved in aqua regia and added insoluble portion.

This insoluble and partly-oxidised portion was now again reduced in hydrogen gas, treated, as before described, with chloride of barium, and, after the removal of the barium, the last traces of platinum and palladium removed by boiling with caustic soda. Rhodium and iridium now alone remained to be separated.

The brown-red fluid was, for this purpose, evaporated with hydrochloric acid, and, after filtration, treated with bisulphite of soda—

$$\left(\begin{matrix}\mathrm{NaO}\\ \mathrm{HO}\end{matrix}\right\} \mathrm{S_2O_4}\right)$$

in *great excess*, and the whole allowed to remain quietly *in the cold* for several days. The double salt of rhodium ($\mathrm{NaOSO_2,RhOSO_2}$) separates slowly, giving a lemon-yellow precipitate. The solution becomes lighter and lighter, and finally almost colourless. The colour of the precipitate changes with that of the fluid, becoming, with it, lighter. This precipitate, upon washing, contained the rhodium almost pure.

Upon heating the fluid gently, a yellow-white precipitate separated, which consisted mainly of rhodium, but contained, also, some iridium. After filtering off this precipitate, the solution, upon being concentrated to a small volume, gave yet two precipitates—

1. A curdy, slowly-separating, yellowish-white precipitate, nearly chemically pure iridium, containing but the faintest traces of rhodium.

2. A heavy, crystalline powder, quickly separating, which was readily freed from the first by decantation, and weighed 16 grms. Upon testing, it gave all the reactions for iridium, but likewise some peculiar reactions not shown by the latter. It may possibly contain a new metal.

Exclusive of these 16 grms., the precipitate (the first) weighed 99·5 grms. The mother liquid was free from platinum metals. The complete separation of rhodium from iridium was accomplished by treating the yellow precipitates with concentrated sulphuric acid. They were brought in small portions into the acid, heated in a porcelain capsule until all the sulphurous acid had escaped, and then left upon the sand-bath until all the free sulphuric acid had been driven off; and the sulphate of soda formed. Upon boiling the mass of water, all the iridium dissolves as sulphate, with a chrome-green colour; while the rhodium remains behind as a flesh-red double salt of soda and rhodium oxide. It (the latter) was washed by boiling in aqua regia, and decanted with water. It is insoluble in water, hydrochloric or nitric acids, and in

aqua regia. The rhodium and iridium are now completely separated. The rhodium salt weighed 33·2 grms.

The following are the weights of the various precipitates obtained from 1 kilo. of the original residue:—

	grms.
$KCl,PtCl_2$	117·5
PdI	77·0
KCl,PdCl	19·0
$NaOSO_3,RhOSO_3$	33·2
Ir_2O_3	9·1
Ru(+Ir)	4·5

The first yellow precipitate obtained in the cold by the bisulphite of soda, gave, by this treatment, the rhodium quite pure. The second and third precipitates, containing much iridium, gave a very fine rhodium, but still slightly impurified with iridium. The products, therefore, obtained by this treatment with sulphuric acid (which betray their impurification with iridium by their somewhat brownish colour) were collected for themselves, the rhodium separated therefrom by glowing, treated again with chloride of barium, and the operation of separation repeated. The green solution, containing only iridium, was gradually heated over an ordinary burner, in a porcelain capsule, and, afterwards, upon the sand-bath, to remove the excess of sulphuric acid; and, finally, the capsule and its contents were highly treated in a Hessian crucible. There is formed thereby sulphate of soda and sesquioxide of iridium. Upon boiling the mass with water, the last remained behind as a black, insoluble powder, which was readily washed by decantation. It weighed 9·1 grms.

In these operations, the new filtering apparatus and the continuous water-bath with which I have furnished my laboratory materially shortened the labour.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

January 20th, 1870.

Dr. A. W. Williamson, F.R.S., &c., President, in the Chair.

The following gentlemen were elected Fellows:—I. Bell, A. Bird, G. R. Hislop, E. Lapper, H. Seward.

The first paper read was—"*Note on the Absorption of Mixed Vapours by Charcoal*," by John Hunter, M.A., Queen's College, Belfast.

The author, some time ago, published, in the *Journal of the Chemical Society* (May, 1868), the results obtained by absorbing the mixture of two vapours by means of cocoa-nut charcoal. He found that the absorption was increased when one of the vapours was at a temperature near to its point of condensation; and he explained the phenomenon by assuming that, when a fragment of charcoal is introduced into a mixture of two vapours, the one which is nearest to its point of condensation is first absorbed, and this, in its condensed state in the pores of the charcoal, aids the absorption of the other vapour. According to this view, a succession of condensations is going on. The theory is strikingly illustrated in experimenting with a mixture of water vapour and ammonia gas (obtained by heating an aqueous solution of ammonia of sp. gr. 0·88), when the mixture is much more largely absorbed than either the gas or the vapour separately. The mean of a set of experiments made at 100° and a mean pressure of 706·2 m.m. was—316·6 vols. of the mixture absorbed by 1 vol. of charcoal.

The President remarked that the results were entirely in accordance with what was expected on theoretical grounds.

The next communication was—"*The Composition of Iron-Rust*," by Dr. Crace Calvert.

The author had lately occasion to analyse rust obtained from two different places—from the outside of the Conway Bridge, and from Llangollen, North Wales; and he found both specimens to be composed as follows:—

Sesquioxide of iron	92·900
Protoxide of iron	6·177
Carbonate of iron	0·617
Carbonate of lime	0·295
Silica	0·121
Ammonia	traces
	100·000

This result induced the author to enquire to which of the constituents of the atmosphere the formation of rust is chiefly due. To this end, clean blades of steel and iron were put into tubes filled respectively with oxygen, oxygen and a little carbonic acid, oxygen and moisture, &c. The blades were introduced into the tubes, which then were filled, over mercury, with oxygen. But this proved an unsatisfactory method, inasmuch as always some globules of mercury remained adhering to the iron, whereby a galvanic action was produced, which, of course, induced a rapid oxidation. To avoid this, the tubes were filled simply by displacement of the atmospheric air. The blades were then left exposed to the action of the different agents for a period of four months. The results were as follows:—

Blades in dry oxygen.—No oxidation.

Blades in moist oxygen.—Out of three experiments, only in one a slight oxidation.

Blades in dry carbonic acid.—No oxidation.

Blades in moist carbonic acid.—Slight incrustation of a white colour. Out of six experiments, two did not give this result.

Blades in dry carbonic acid and oxygen.—No oxidation.

Blades in moist carbonic acid and oxygen.—Most rapid oxidation.

Blades in dry oxygen and ammonia.—No oxidation.

Blades in moist oxygen and ammonia.—No oxidation.

These facts led the author to assume that it is the presence of carbonic acid in the atmosphere, and not oxygen or water vapour, which determines the oxidation of iron.

The author next investigated the behaviour of iron in water into which, successively, oxygen, carbonic acid, a mixture of the two gases, &c., was conducted. The results were analogous to those above mentioned, inasmuch as the most effective oxidation took place when a mixture of oxygen and carbonic acid was introduced into the water. The action commenced immediately, and, in a short time, a dark precipitate covered the bottom of the vessel. The oxidation, in these cases, was not due to the fixation of the oxygen dissolved in the water, but to oxygen liberated from the water by galvanic action; the occurrence of hydrogen collected above the liquid in the bottles proved this sufficiently. A further evidence for the supposition that the oxidation of the iron is effected through the decomposition of the water is found in the fact that, when into distilled water which had previously been deprived of all its absorbed gases by continued boiling a bright blade is introduced, it became, in the course of a few days, here-and-there covered with rust. The spots where the oxidation had taken place proved to be impurities in the iron, which had induced a galvanic action, just as a mere trace of zinc, placed on one end of the blade, would establish a voltaic current.

Finally, Dr. Calvert investigated the state of iron in alkalies; and he discovered that, not only the solutions of the caustic alkalies, but of their carbonates as well, protect iron against any oxidising action.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

THE CHAIRMAN said that he had observed, at Cheetham Hill, on the evening of Monday, the 3rd inst., at 7.30 p.m., a singular display of the Aurora Borealis. It consisted of an arch of white light, 4° to 5° in breadth, a little south of the zenith, extending from east to west, and passing through the Pleiades; and a column of deep crimson colour, nearly due north, extending from the horizon to about 40° altitude, having slightly the character of streamers. The white arch, also, moved slowly to the south. The intensity of the red colour in the pillar was greater than any he had previously observed.

Dr. JOULE said he had not seen the aurora of the 3rd instant referred to by the Chairman; but, having been engaged on the same day in making observations with his new dip circle, he had noticed some remarkable disturbances in the magnetic dip, which no doubt were connected with the auroral display. He had also noticed similar disturbances of the dipping needle during the gale on Saturday, the 8th instant.

Dr. JOULE exhibited his current meter, and with it, in connection with a galvanometer, made an experiment to determine the horizontal intensity of the earth's magnetism in absolute measure. The result gave 3·83 as the value of this element in the hall of the Society. The current employed was produced by a single cell of a Bunsen's battery.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

January 3th, 1870.

R. D. DARBISHIRE, B.A., F.G.S., in the Chair.

Dr. W. ROBERTS exhibited some specimens of urinary calculi, composed of cystine; also some crystals of the same, obtained by evaporation in the open air of the ammoniacal solution. Six-sided plates of mother-of-pearl lustre were obtained in this way which formed brilliant objects for the microscope.

Dr. ROBERTS remarked on the great rarity of cystine calculi, many large museums not possessing a single specimen. He had, in his own collection, three specimens; and, in the Museum of the Manchester School of Medicine, there were portions of two very fine calculi. A certain historical interest attached to one of the latter, a piece of which was presented, by the late Mr. Ransome, to Baron Liebig, during one of his visits to Manchester. The analysis of this piece led to the rectification of a curious error in the original formula for cystine, published by Prout and Lassaigne. These eminent chemists had deduced the formula $C_6H_6NO_8$; but the Giessen analysis discovered 20 per cent of sulphur, which brought the true formula to $C_6H_6NS_2O_4$, the 2 atoms of sulphur having been before erroneously reckoned as 4 atoms of oxygen.

Mr. J. SIDEBOTHAM read "*Notes on the Pupa and Imago of Acherontia atropos.*"

Mr. W. BOYD DAWKINS sent, for exhibition, some very interesting microscopic sections of *Eozöon Canadense*, which are the more valuable as being those which have passed through the hands of Sir W. E. Logan and Dr. Carpenter.

Mr. J. B. DANCER, F.R.A.S., presented the Section with a box containing twelve new polarising objects. These partly consisted of some of the hard fatty acids, which form very effective objects, and partly of crystallisations of some of the hydrocarbon compounds, which compete with the best specimens of polarising objects of the present day.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

THE ordinary meeting of the Chemical Section was held on Monday last, Mr. Alexander Whiteland, Vice-President, in the Chair. After the admission of some new members and the transaction of some other business, a paper was read by

Mr. J. WALLACE YOUNG, "*On Artificial Alizarine.*" He characterised madder and its preparations as being among the most useful dye-stuffs used in calico-printing and dyeing. The importance of madder is due to the fact that with different mordants it gives a great variety of colours,—iron mordants giving all shades from black to delicate purple; those of alumina giving colours from a dark red to a fine pink; and a mixture of them giving various shades of chocolate. Madder root has undergone probably more chemical investigation than any other colouring matter—the investigators being Robiquet and Colin, Claubry, Persoz, Runge, Schunck, Higgin, &c. The most important colouring matter is alizarine; from it may be obtained all the durable and brilliant colours yielded by madder itself. Mr. Young described the method by which alizarine may be obtained readily from madder root, and mentioned that the substance appears ultimately as a sublimate of fine orange-red needles, which are slightly soluble in hot water, and readily soluble in boiling alcohol. Owing to the high price of madder and madder preparations, much interest attaches to every substance which purports to be a substitute for madder. A good substitute would be gladly welcomed. M. Roussin announced a few years ago that he had succeeded in obtaining artificial alizarine from napthalin, but further investigation proved that he had been mistaken. More recently, it had been announced in the CHEMICAL NEWS and elsewhere that artificial alizarine had been successfully obtained from anthracen.

Mr. Young then stated the results of his experiments upon two madder substitutes, one of continental manufacture, a thin dark coloured paste containing 5·7 per cent of dry residue, the other of English manufacture, supplied in the form of an opaque brownish liquid. The former contained a large amount of coloured matter, but further purification was necessary before it could be used as a madder-substitute. When mordanted cloth dyed with it was boiled with solution of soap, the colours were found to be rather fugitive. Cloth prepared for Turkey-red absorbed the dye-stuff readily, but the same want of fastness was observed. When mixed with iron and aluminous mordants, and printed on in the way in which madder extract is used, the colours were found to be dull and not sufficiently fast. A sublimate obtained from the dried paste closely resembled natural alizarine, but was rather lighter in colour. It dyed mordanted cloth well and withstood treatment with soap. The English made madder substitute yielded a red rather yellower than that yielded by natural alizarine, a black of equal, if not superior quality to madder-black, but the chief difference was in the purple, which was rather slate-coloured than anything else, contrasting most unfavourably with the fine shade of colour given by madder. The yellowness of the red seemed to depend pretty much on the proportion of tin salt used in the clearing. As with madder and its preparations, the development of the colouring matter of the artificial alizarine is increased by tanning materials, as sumac, and deteriorated by chalk. The dried residue of the brown artificial alizarine liquid yielded by sublimation a crystalline body of a yellower shade than that of the crystals of the natural alizarine. In order to compare the artificial alizarine with the natural substance and with purpurine, which is another madder extract, the author dissolved each of them in weak ammonia, and added barium chloride; they all yielded purplish precipitates. The natural alizarine precipitate was of a fine

bluish-purple colour, and the supernatant liquor was almost quite clear; that from the artificial product was much redder, and the supernatant liquid was highly coloured; the purpurine precipitate was of a purplish-red colour. The natural alizarine and purpurine precipitates did not seem to be much affected by being washed several times with cold water, but the artificial alizarine precipitate gradually dissolved in the washing water and finally disappeared. Mr. Young thoroughly tested the dyeing powers of the new alizarine by comparing the results produced upon mordanted cloth either with equal weights of sublimed alizarine obtained from the two artificial preparations and from madder, and of purpurine; he showed the specimens of cloth so treated. Instead of the dark full red given by the natural substance, the artificial alizarine yielded only a yellowish-red, much like that of the purpurine. Its purple was of a slatey tint, but the chocolate and black differed very slightly from those of the natural alizarine. The purpurine scarcely gave any purple, and the same is true of the Continental and English madder-substitutes. Alcoholic solution of natural alizarine gives a fine purple colour with copper acetate, and with the same reagent the artificial preparation gives a very red purple. No characteristic bands appear in the spectrum when artificial alizarine is used, and, therefore, purpurine is shown to be totally absent. The author was not aware if anything had been done towards establishing a formula for the new alizarine, but, his opinion arrived at after performing many practical experiments, was that there was some essential difference between the artificial and the natural substance. He had found no superiority in the new substance. In a supplement to the paper of which the foregoing is an abstract, Mr. Young said that the manufacture of artificial alizarine is carried out in two or three ways by continental chemists, and from the examination which has been made of the products, it would appear that some of them consist of a mixture of alizarine and purpurine, in different proportions, and some of alizarine, or of a substance intermediate between the two. It had been said that it was more advantageous to use the artificial alizarine as a dry paste, rather than in the dry state, but he could find no difference in the dyeing power. He had treated the artificial alizarine with boiling dilute sulphuric acid, as in garancine making, afterwards washing thoroughly and drying: he had also dissolved it in sodium carbonate, precipitating with acetic acid, washing, and drying; but the colours given on drying did not seem to be modified in any way.

A discussion followed, in which several gentlemen took part. There seemed to be much doubt as to the mode of preparing the artificial alizarine, and if it could be produced in large quantity, considering the small amount of anthracen, which exists in coal-tar. On that point, however, it was stated by Mr. Hogg that it could be supplied in considerable quantities and at such a price as would make it cheaper than madder.

A paper then followed "*On the Estimation of Iodine and Bromine in the Mother Liquors from Saltpetre and in Kelp*," by Dr. Clark. The author submitted a process by which the tediousness may be avoided which attends most of those which aim at estimating iodine and bromine existing in the combined state in presence of a large excess of chloride. He considered it specially applicable for the estimation of iodine and bromine in the mother liquors from saltpetre. A measured quantity of the liquor is introduced into a long tube with twenty alkalimeter measures of bisulphide of carbon; and nitrous-sulphuric acid (prepared by passing nitrous acid through sulphuric acid) is added, drop by drop, till iodine ceases to be liberated. The tube is inverted several times after the addition of each drop of acid, in order that the iodine may at once be dissolved by the bisulphide of carbon, to which it gives a violet colour, varying in intensity with the amount of iodine in solution. The quantity of the iodine is estimated by comparing the degree of the colour with that which results when a standard solution of iodide of potassium is used in the same way. The author affirmed the delicacy of the reaction to be such, that 0·01 gr. would communicate a distinct rose tint to the bisulphide of carbon. When the amount of iodine exceeds 0·2 gr. of iodine in the quantity operated on, a difficulty occurs, as the violet colour becomes so deep that the various shades cannot be distinguished with accuracy. When all the iodine is separated by the bisulphide of carbon, the solution containing the bromine is introduced into another tube, and the bromine is liberated by chlorine-water in the usual way, and taken up by a fresh quantity of bisulphide of carbon. In this case, an orange colour is the result, and the amount of bromine may be estimated by comparing the colour with that resulting when a solution of bromide of potassium is used of known strength. A sample of saltpetre mother liquor treated in the way mentioned gave the results—

Iodine	145·3 grs.	per gallon.
Bromine ..	2094·5 ,,	,,

The same process, slightly modified, may be used to determine the amount of iodine and bromine in kelp.

Mr. Stanford said that, so far as iodine was concerned, the process mentioned by Dr. Clark was a good commercial process, but he doubted if it would be of use with bromine.

Mr. Tatlock considered that the process was not specially novel, and that it was liable to the same objections that apply to colour tests generally. He could put little or no confidence in such tests.

CORRESPONDENCE.

THE CAVENDISH SOCIETY.

To the Editor of the Chemical News.

Sir,—It may be satisfactory to many of the old members of the Cavendish Society to be informed that the Society is not extinct. I was present at the last public meeting, held under the presidency of Mr. Graham, when it was resolved—1. To accept the offer of Messrs. Harrison to relieve the Society from its liabilities, and to complete the translation of "Gmelin's Chemistry," including a full index, on the condition that the Society surrender to Messrs. Harrison the remainders of the works issued by the Society (already printed and published by Messrs. Harrison), and also the right of sale, at a stipulated price, of the volumes required to complete "Gmelin's Chemistry." 2. That the President, Council, and Secretary, hold office until this engagement with Messrs. Harrison be fully carried out.

Mr. Watts has already explained the cause of the delay in the completion of "Gmelin." Subscribers will see that their interests have been cared for by the President and Council. The Council can meet, at any time, with full powers to act. Should such a meeting be necessary, their first duty will be a melancholy one, namely, to elect a new President, and then, having agreed that the engagement with Messrs. Harrison has been fully carried out, to dissolve the Society.

Although a Member of the Council I have no official authority whatever for making the above statement, nor do I know of any means, short of summoning the Council, for procuring such a statement. But as so many inquiries and complaints have been made respecting the present position of this Society, I trust it will not be thought impertinent if I thus supplement Mr. Watts's letter.—I am, &c.,

C. Tomlinson.

Highgate, N., Jan. 24, 1870.

GMELIN'S CHEMISTRY AND WATTS'S DICTIONARY.

To the Editor of the Chemical News.

SIR,—Every chemist and possessor of "Gmelin's Chemistry" will, I am sure, in common with myself, be glad to have seen Mr. H. Watts's letter in the last number of the CHEMICAL NEWS, and to hear that there is at last a chance of this very valuable work being completed.

Whilst on this subject, I would refer to Mr. Watts's "Dictionary of Chemistry," and should like to know if there is any probability of the hint being acted upon, which, I believe, you originated at the time this latter work was completed—viz., the annual publication of a supplement which would contain the contributions to chemical science for the year preceding. Such a book is published in Germany, and is a great boon to all chemists; but, with a work like Watts's "Dictionary" as a starting point, the further labours of its eminent compiler, than whom there is no one more competent, would be much more valuable.

I am sure that all my brother chemists would only be too glad to purchase the book at a price which would well remunerate the publishers.

JOHN G. DALE.

Laboratory, Mersey Bank,
Warrington, January 22nd, 1870.

OBITUARY.

A. PAYTON HURLSTONE.

WE record, with pain, the death of a valued friend and talented contributor to the CHEMICAL NEWS. Adam Payton Hurlstone, M.R.C.S., M.B., B.Sc., &c., died on the 21st of December, in the 24th year of his age, on board the steamship *Laplace*, on his passage from Brazil, where he had been pursuing his studies in botany, geology, &c.; he was buried the same day, at sea. Since leaving Cheltenham Grammar School, Mr. Hurlstone's scientific and medical studies had been pursued at University College, where he distinguished himself by carrying off, at an early age, the highest prizes for which he competed. It is to be feared that his unremitting devotion to study, acting on a frame not naturally robust, sowed the seeds of premature disease; and, with a view of combating unfavourable symptoms, he was advised to try the effect of foreign travel and sea voyages. We had great hopes that his health would, by this means, have been restored, and that he would soon have been enabled to continue that career of usefulness of which his talents gave such ample promise. At one time, he was a frequent contributor to the CHEMICAL NEWS, and some of the best reviews and unsigned articles which have ever appeared in these pages were from his pen. His relatives wish to take this opportunity of intimating their great loss to his many scientific friends.

MISCELLANEOUS.

The Royal Mint.—Mr. W. Chandler Roberts, F.C.S., Ass.R.S.M., has been appointed chemist to the Mint. We call attention to this with the greater pleasure because it is a new chemical appointment in connection with the Government. The laboratory will, we believe, be partly devoted to research—the first laboratory of this sort established by the Government. Mr. Roberts was for some years assistant to the late Professor Graham, and associated with him in hydrogenium researches; we, therefore, hope that Mr. Roberts will continue his experiments on this subject, and that this new recognition of science on the part of the Government may lead to many useful discoveries.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, January 3, 1870.

This number, a great portion of which is devoted to the records of the proceedings of the elections of President, Vice-Presidents, and *Membres du Bureau*, contains the following original papers and memoirs relating to chemistry and allied sciences:—

On the Nascent State.—M. St. Claire-Deville.—This paper is identical with that already briefly alluded to (see CHEMICAL NEWS, vol. xxi., p. 36).

Action of Magnetism upon Gases.—M. Trève.—This paper contains a first short account of a series of experiments made with perfectly pure gases enclosed in so-called Geissler tubes, and submitted to the action of the induction-spark and an electro-magnet of great force.

Origin of Nitrogen Gas Present in what is supposed to be Perfectly Pure Oxygen.—M. Houzeau.—The author mainly states that atmospheric air adheres with so great tenacity to all parts of the apparatus employed for the production of oxygen and hydrogen, that the author found it necessary to heat to redness even narrow tubes, in order to expel the air, while at the same time a rapid current of pure oxygen passed through the same.

Some Remarks on the Artificial Manufacture of Precious Stones.—M. Gaudin.—The author states, in reference to what has been done on this subject by M. Feil, that he (the author of this paper) made artificial precious stones in crucibles many years ago, but that it is far more difficult to obtain really good results by that method than by the use of the oxyhydrogen blowpipe, and that only by the use of the latter really hard stones, not acted upon by the file, can be made.

Motion of Chlorophyl Globules Under the Influence of Light. M. Prilleux.—A botanico-physiological paper.

Manufacture of Platinised Looking-Glasses.—M. Jouglet.—Abstracted from another periodical.

Two Products from the White Agaricus.—M. Fleury.—The dried agaricus (a kind of mushroom) yields, on being treated with ether, after evaporation of that fluid, two substances—viz., a resin, $C_{21}H_{22}O_{10}$; and agaricic acid, $C_{16}H_{32}O_4$.

Toxicological Properties of Some Rosolates.—M. Guyot.—The author states that the rosolates of potassa, soda, and baryta do not at all act upon the skin; the soda and potassa salts are not poisonous when they are inwardly taken, or introduced into the animal system; rosolate of baryta is poisonous in strong dose, in consequence of the poisonous properties of the base itself.

January 10th, 1870.

Nitrous Acid.—M. Fremy.—The author considers this acid under the three following headings:—(1) Action of water upon nitrous acid. This decomposition is represented by the following formula:—

$$3NO_3+HO=NO_5,HO+2NO_2.$$

This reaction is modified, however, by the relative quantities of acid and water, as well as by the temperature. When the acid is in excess, there is only nitric acid and deutoxide of nitrogen formed. When a large quantity of cold water is brought into contact with nitrous acid, the latter dissolves in the water, and no decomposition whatever takes place; this solution is far more staple than one would at first think—even a boiling heat does not destroy it at once. (2) Reducing action of the acid.—In this respect, the aqueous solution just alluded to has some similarity with sulphurous acid, chloride of gold is reduced instantaneously, and permanganate of potassa is decomposed. Nitrous acid decomposes sulphuretted hydrogen precisely in the same manner as sulphurous acid does. The author discusses, at some length, the action of nitrous and sulphurous acids in their respective relations to the manufacture of sulphuric acid; and, from his observations, he comes to the conclusion that an excess of sulphurous acid gas in the leaden chambers, and too high temperature, are the real causes of the useless waste of nitrous compounds in the manufacture of sulphuric acid on the large scale. (3) Decomposition by means of

hydrogen.—While experimenting on this subject, the author has discovered a new substance in the following manner:—Nitrate of potassa is calcined in a platinum crucible, and nitrite of potassa formed; this is dissolved in water, and the solution thus obtained submitted to the action of sodium amalgam. The nitrite becomes reduced, and the new substance is obtained, exhibiting the following properties:—It decomposes instantaneously, and at the ordinary temperature, the salts of gold, silver, mercury, and copper, yielding, with the three first-named, the pure metals, and, with the last, the hydrated peroxide. Even when an excess of alkali is present, permanganate of potassa solution is instantaneously decolourised; heated with an excess of alkali, ammonia and protoxide of nitrogen are given off, and the reducing properties are at once lost. The researches on this substance are not finished yet.

Eighth Memoir on the Electro-Capillary Phenomena. Part II. On the Cause of Electric Currents of the Muscles. Nerves, and Bones.—M. Becquerel.

Estimation of Weak Electro-Motive Force.—M. Becquerel.

Constitution of the Solar Aureola, and on the Phenomena Exhibited by Rarefied Gases Rendered Incandescent by means of Electric Currents.—Rev. Father Secchi, S.J.—A lengthy paper accompanied by several diagrams.

Manufacture of Tam-Tams and Cymbals.—MM. Riche and Champion.—This paper gives a description of the mode of manufacture of the metallic drums often imported from China under the name of gongs. The alloy made use of by the authors consists of 78 per cent of copper and 22 per cent of tin. The operations chiefly consist in a well-managed beating out and annealing of the disc, which is cast of a thickness of 23 m.m. originally.

Action of Dry Chlorine upon Dried Nitrate of Silver.—MM. Odet and Vignon.—The authors, referring to a former paper published by them on this subject, now state that there are two phases to be distinguished in the reactions which here take place—viz., first, chloride of azotyl is formed, and oxygen set free; and, secondly, the chloride of azotyl reacts upon the excess of nitrate of silver. The following formulæ represent these phases:—

$$\text{1st.}\quad \left.\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2+\left\{\begin{matrix}Cl\\Cl\end{matrix}\right\}=\left\{\begin{matrix}Cl\\Ag\end{matrix}\right\}+O_2+\left\{\begin{matrix}NO_4\\Cl\end{matrix}\right.$$

$$\text{2nd.}\quad \left.\begin{matrix}NO_4\\Cl\end{matrix}\right\}+\left\{\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2=\left\{\begin{matrix}Cl\\Ag\end{matrix}\right\}+\left\{\begin{matrix}NO_4\\NO_4\end{matrix}\right\}O_2.$$

Synthesis of Hydrosulphuric Acid.—M. Boillot.—The author states that, having filled gas jars with hydrogen, and having placed some sulphur in the same, the passing of an electric spark through the latter, igniting and volatilising it, produced a perceptible quantity of sulphuretted hydrogen.

Analysis of the Waters Contained in Arable Soils.—M. Schlœsing.—This interesting paper is chiefly made up of results placed in a tabulated form, and, hence, not well suited for useful abstraction.

Reply to M. Guadin's Paper "On the Manufacture of Artificial Precious Stones.—M. Feil.—A question of priority.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 17, 1869.

This number contains the following original papers:—

The Antecedents (Vorstufen) of Urea in the Animal Organism.—MM. Schultzen and Nencki.—This paper, communicated from the chemical laboratory attached to and forming part of the anatomical dissection rooms, contains the record of a series of experiments instituted with dogs in order to elucidate, and, if possible, explain, the mode of the formation of urea and the prodromi of that substance.

Iodide and Bromide of Mercury.—M. Oppenheim.—The iodine compounds of the alcohol radicals do not act upon bichloride and bibromide of mercury in the same manner. In the case of the iodides of the alcohol radicals and the bichloride of mercury, there is formed at once an organic chloride and red iodide of mercury; but when organic iodides are brought into contact with bibromide of mercury in alcoholic solution, no action takes place. When, however, bibromide of mercury is dissolved in acetone, and the experiment repeated with this solution, a yellow crystalline substance is obtained; on investigation, this substance proved to be soluble in ether, to sublime without decomposition, and to have for its formula HgIBr. The authors observe that the formation takes place according to the formula $RI+HgBr_2=RBr+HgBrI$, and that its composition is a new proof of the correctness of the atomic weight of mercury = 200.

Isomorphism of the Compounds of Mercury containing Two Atoms of Chlorine, Bromine, Iodine, and Cyanogen.—M. Groth. A crystallographical paper illustrated by diagrams.

Critical Remarks upon the Paper Read by M. Thomsen, "On the Estimation of the Heat Given Off by the Combustion of Organic Compounds."—M. Baeyer.

Cresylo-Purpuric Acid.—M. von Sommaruga.—The raw material employed by the author for his experiments is trinitro-cresylate of ammonia, an article of commerce known under the name of Victoria yellow. After having purified this salt by re-crystallisation, it was dissolved in water, and yielded, on the addition of hydrochloric acid, trinitro-cresylic acid. Instead of treating this acid with cyanide of potassium, the author prefers to use the purified Victoria yellow at once, and obtains, on addition to that substance an aqueous solution of the cyanide just named, the cresyl-purpurate of potassa, $C_8H_6N_5KO_8$. When dry, this substance, on being suddenly heated, detonates. A concentrated solution of this salt yields, on being mixed with a concentrated solution of chloride of ammonium, the ammonia salt of the new acid—viz., $C_8H_6N_5(NH_4)O_8$.

Researches on Sandal-Wood.—M. Weidel.—After referring to some old researches on this subject, the author states that he exhausted 20 lbs. of the sandal-wood shavings, first, with boiling water, to which some caustic potassa had been added. The deep red-coloured liquid was neutralised with hydrochloric acid, whereby a bulky brick-coloured precipitate was thrown down. This substance was collected on filter, washed, and dried, and next treated with ether, the excess of the latter removed by means of distillation, the residue diluted with alcohol, and left to evaporate by itself. The author thus obtained, among several coloured substances, a colourless crystalline body, which is soluble in boiling alcohol. This substance, not hitherto known, has been called by the author "santal;" it is only readily soluble in dilute solutions of caustic alkalies, but these solutions soon become coloured while in contact with air, passing from red, through green, to a dirty brown. The alcoholic solution of santal is neutral to test paper, and is coloured deep red with perchloride of iron. Concentrated sulphuric acid dissolves santal, exhibiting a lemon-yellow coloured solution; formula of the dry substance, $C_8H_6O_3$. The author also found a cinnabar-red coloured crystalline material, which he called "santaline," though it is not quite identical with the santalin of M. Meier; according to M. Weidel's analysis, this santalin is $C_{14}H_{12}O_4$. It is probable that santal is in some manner connected with santalin, but this point is a subject for ulterior investigation.

Double Cyanogen Compounds.—M. Weselsky.—This lengthy memoir is divided into the following sections:—Double cyanides, having the general formula $BaCy_2.R_2Cy_2$; sodiumcobaltocyanide, $Na_6CO_3Cy_{12}.4H_2O$; ammoniumcobaltocyanide, $Am_6CO_3Cy_{12}$; phenyl-ammoniumcobaltocyanide, $(C_6H_8N)_6.CoCy_{12}$. And a series of more and more complicated bodies, as instance of which we quote—phenyl-ammoniumcobaltocyanide phenylammonium hydrate—

$$(C_6H_8N)_6Co_2Cy_{12}.2(C_6H_9NO).$$

Preparation and Properties of Hydrate of Chloral.—M Thomsen.

Preparation of Selenic and Selenious Acid.—M. Thomsen.—Selenium is acted upon with concentrated nitric acid, and the solution obtained is evaporated until selenious acid begins to sublime; the residue is dissolved in water. This solution may contain, beside selenious acid, some sulphuric and selenic acid; in order to separate these from each other, baryta water is added. Since selenite of baryta is readily soluble in an excess of selenious acid, the addition of baryta water is continued until a small quantity of the fluid having been filtered does not yield any longer a permanent precipitate on the addition of some more baryta water. The fluid, having been filtered, is evaporated to dryness and submitted to sublimation; the selenious acid thus obtained is quite free from selenic and sulphuric acids. Selenic acid is prepared from this selenious acid by dissolving the latter in water, precipitating this solution with nitrate of silver; the insoluble selenite of silver thus obtained is shaken up with a mixture of water and bromine until the latter is in slight excess. The solution, having been filtered and concentrated by evaporation, yields selenic acid, quite free from sulphuric or selenious acid.

Simple Method for Recovering Iodine from Iodide of Mercury.—M. Henry.—The iodide of mercury is digested with water to which granulated zinc or iron borings are added. A soluble iodide of zinc or iron is obtained; from which the iodine is separated by means of sulphurous acid.

Parachlorotoluidine.—MM. Henry and Radziszewski.—The substance is a solid, hard, brittle, white-coloured body, fusing at 85°, and boiling, without decomposition, at 243°.

Contribution to the History of Sulphuretted Ureas.—Dr. A. W. Hofmann.—A lengthy and concisely-written memoir, not well suited for abstraction.

Some Ethers of Cresol.—M. Fuchs.—The author describes—Ethylcresol, $C_9H_{12}O$; ethylparaoxybenzoic acid, $C_9H_{10}O_3$; ethylencresol, $C_{18}H_{18}O_2$; acetylcresol, $C_9H_{10}O_2$.

Paratoluidine and Bromotoluol.—M. Wallach.—A critical review of M. Rosenstiehl's labours on this subject.

Revue Hebdomadaire de Chimie, January 13, 1870.

Action of Sulphuretted Hydrogen upon Hydrated Peroxide and Peroxide of Iron at the Ordinary Temperature of the Air.—M. Brescius.—The author has investigated this reaction by means of the following experiment:—Chemically-pure hydrated peroxide of iron was placed in a glass tube, and all the air expelled by means of a current of carbonic acid gas, which was made to pass, previously to reaching the tube, through freshly-precipitated carbonate of iron suspended in water, in order to remove from the carbonic acid every trace of atmospheric oxygen. A current of sulphuretted hydrogen (also free from air) was then passed over and through the hydrated peroxide for twenty-four hours, and the excess of the latter gas removed by a current of dry and pure carbonic acid, care being taken to bring the temperature to 50°, in order simultaneously to dry the sulphuret obtained. The product thus obtained oxidises only very slowly in contact with dry air, and contains hardly more than mere traces of free sulphur. The author, therefore, concludes that the reaction takes place according to Berzelius's view, represented as follows:—$Fe_2O_3+3HS=Fe_2S_3+3HO$. When perfectly pure and dry peroxide of iron is experimented with under the same conditions, no reaction whatever ensues.

Action of the Oxygen of the Air upon Sulphuret of Iron.—M. Wagner.—According to the author, sulphuret of iron does not,

when exposed to air, change into sulphate or sub-sulphate, but is converted into sulphur and peroxide of iron. Only traces of sulphuric acid are formed at the ordinary temperature; and only when more heat is applied is this acid more abundantly formed. In order to prove this by experiment, monosulphuret of iron was carefully prepared, and divided into three portions. One of these was kept constantly moist, and at nearly 100°, during three weeks. The second was also kept moist, and left at the ordinary temperature of the air. The third, after having been previously dried, was, for three weeks, left in contact with dry air at the ordinary temperature [the sulphuret was dried by means of a current of illuminating gas, at 100°, since a current of air, dried by means of strong sulphuric acid, oxidises the material]. The results of the analysis of these samples, recorded percentically, gave, for—(I.) Sulphur, 24·35; sulphuric acid, 7·76; ferrous oxide, 61·72; ferric oxide, 6·17. (II.) Sulphur, 28·32; sulphuric acid, 0·96; ferrous oxide, 61·51; ferric oxide, 9·21. (III.) Sulphur, 27·94; sulphuric acid, 2·39; ferrous oxide, 46·43; ferric oxide, 23·24.

Platinised Looking-Glasses.—M. Jouglet.—The platinising compound is prepared in the following manner:—100 grms. of very thin platinum foil is dissolved in aqua regia, the solution carefully evaporated to dryness, the solid chloride next placed on a triturating marble, and gradually mixed with essential oil of lavender. When 400 grms. of the latter have been incorporated with the chloride, the mixture is placed into a porcelain capsule and left standing for several days, the fluid is decanted from any sediment, and filtered as flux. For the above-named quantity of platinum, the following ingredients are used:—25 grms. of litharge and 25 grms. of borate of lead, mixed and triturated together with about 10 grms. of essence of lavender; this mixture is next mixed with the platinising fluid. After a layer of platinum has been formed upon the glass, it is fixed by burning it in by placing the glass in peculiarly-constructed muffles.

Depositing Copper upon Cast-Iron.—M. Weis-Kopp.—The pieces of cast-iron are first placed in a bath made of 50 parts of hydrochloric acid, at 15° Beaumé (sp. gr., 1·105), and 1 part of nitric acid; next, in a second bath, composed of 10 parts of nitric acid, 10 parts of chloride of copper, dissolved in 80 parts of the same hydrochloric acid as just alluded to. The objects are rubbed with a woollen rag and a soft brush, next washed with water, and again immersed until the desired thickness of copper is deposited. When it is desired to give the appearance of bronze, the coppered surface is rubbed with a mixture of 4 parts of sal ammoniac and 1 each of oxalic and acetic acids dissolved in 30 parts of water.

Cosmos, January 15, 1870.

Universal Galvanic Battery.—M. Delaurier.—The author describes, at great length, and accompanied by a woodcut, a Bunsen cell modified by him. He uses an impure chromic acid, and a mixture of persulphate of iron and sulphuric acid. How the impure chromic acid is prepared is not mentioned. Instead of sulphuric acid, a solution of common salt (1 part in 10 of water) is often applied, and the amalgamation of the zinc is dispensed with; this arrangement appears, according to the statements made, to be satisfactory in many instances. The intensity of the action of the cell when chromic acid, persulphate of iron, and sulphuric acid are used, is very great, and the vapours of hyponitric acid, so deleterious with the Bunsen cells, are, of course, avoided.

Gases in Arable Soil.—M. Hervé-Mangon.—Akin to most porous substances, arable soil has the property of condensing gases. The author finds that the quantity of gases thus condensed varies in bulk (for the same quantity of soil) from 2 to 10 volumes of gas.

Railway from Arequipa to Puno and Cusco (Peru).—The highest point above sea level of this railroad is 4633 metres (15,096 English feet)*—that is to say, more than twice the height above the level of the sea that any existing railroad has reached. At the altitude just named, the air is only half as dense at the surface of the ocean; in other words, when the average height of the barometer at the last-named surface is taken at 28 inches at the height alluded to, its average reading will be only 14 inches.

Archives Néerlandaises des Sciences Exactes et Naturelles, vol. xiv., 1869.

This periodical is published at irregular intervals of time, in volumes containing from six to twelve sheets 8vo. The editor, Dr. E. H. von Baumhauer, the Secretary of the Holland Society of Sciences at Haarlem, is assisted by a number of eminent scientific men. This volume contains the following original papers and memoirs:—

Observations on the Periodical Errors of Micrometer Screws made During the Latest Re-Arrangement of the Astronomical Observatory of Leyden University.—M. F. Kaiser.

Improved Method of Direct Estimation of Iron in the State of Peroxide by means of Hyposulphite of Soda.—M. A. C. Oudemans, jun.—Reserved for full translation, since it bears upon an important subject.

Synthesis of Terephthalic Acid.—M. A. C. Oudemans.—After referring to the labours of M. Carius on the subject of the products of the oxidation of benzol, the author states that he found that, beside formic and phthalic acids, there is also formed terephthalic acid, $C_8H_6O_4$. The quantity obtained of that substance is, however, very small. The preparation, and some of the reactions of this acid, are described at great length.

* The height of Mont Blanc is, according to Tralles, 14793.

Specific Gravity of some Saline Solutions.—M. A. C. Oudemans.—This paper contains a series of tabulated results of the specific gravity of aqueous solutions of the following salts:—Crystallised sulphate of magnesia, at 14°, and in quantities of from 1 to 40 per cent of the quantity of water; crystallised nitrate of magnesia, at 14°, and in quantities of from 1 to 49 per cent of the quantity of water; crystallised chloride of magnesium, $Mg''Cl_2+6aq$, at 14°, and in quantities of from 1 to 48 per cent of the quantity of water; crystallised nitrate of of manganese, at 8°, and in quantities of from 1 to 71 per cent of the quantity of water; crystallised acetate of lead, at 14°, and in quantities of from 1 to 33 per cent of the quantity of water; crystallised nitrate of zinc, at 14°, and in quantities of from 1 to 50 per cent of the quantity of water.

Application of Avogadro's Theorem to Chemistry.—Dr. J. W. Gunning.

Albuminous Substances of the Blood.—Dr. Heynsius.—A lengthy and very valuable chemico-physiological memoir.

General Registering Apparatus.—Dr. Heynsius.—To this paper is added an engraving, essential for the proper understanding of the subject.

Means of Preserving Wood from being Attacked by the Teredo Navalis.—Dr. E. H. von Baumhauer.—This paper, too lengthy for useful abstraction, contains the results of experiments made with various kinds of wood, among these several samples brought on purpose, from the Netherlands' West Indies; as well as the results of impregnating European wood with various preservative and other substances. The main result is that, among the latter, creosoting is the only active agent, provided the creosote applied contains a large quantity of carbolic acid and the impregnation be complete.

Absolute Expansion of Mercury according to M. Regnault's Experiments.—M. Bosscha.

Method of Analysis of Milk.—Dr. E. H. von Baumhauer.—A valuable and extensive memoir on this subject, but, owing to the engravings and large number of tabulated forms added, not suited for useful abstraction.

Nature of the Fluids Enclosed in some Minerals.—MM. Vogelsang and Geissler.

Mineral Oils of the Netherlands' East Indian Possessions.—Dr. E. H. von Baumhauer.—A very valuable memoir not only for the knowledge it contains on the subject, but owing to its containing compilations from an immense number of analyses and researches on mineral oils dispersed through a large number of periodicals.

Extent of Surface Occupied by the Deposits of the Various Geological Formations in the Netherlands.—M. Hartogh Heys van Zouteveen.—From this paper, we learn that the following geological formations are found in the kingdom above named:—Jurassic terrain; cretaceous terrain; tertiary formation; quartair formation, sub-divided into diluvium and modern, or recent formations. The extent of each, and of every distinct species thereof, is accurately exhibited; the curious result arrived at is that 99·9 per cent of the soil of the Netherlands belongs to the quartair formation, while all the rest occupies only obout 0·1 of the entire surface (3,283,927 hectares, fully more than 13,000 English square miles. No other country on the face of the globe presents a similar physical constitution.

Periodical Evolution of Gas in the Protoplasma of the Living Arcellæ.—M. Hartogh Heys van Zouteveen.

Electrical Irritation of Amibæ and Arcellæ.—M. Hartogh Heys van Zouteveen.

Estimation of the Velocity by which a Luminous Ray is Carried Forward through a Moving Medium.—M. Hoek.

Refraction and Dispersion of Flint Glass, Crown Glass, Quartz, and Iceland Spar.—MM. van der Willigen.

NOTES AND QUERIES.

Detection of Fatty Oils from Seeds of Cruciferæ.—With reference to the method for detecting these oils by boiling with caustic potassa in a silver capsule, M. Grehaut is probably not aware that his process is no novelty. It was known in England prior to the year 1861, and is described in a work bearing that date.—J. W. SLATER.

Test for Soaps.—In the CHEMICAL NEWS (vol. xx., p. 44), Professor Schulze proposes to estimate the goodness of soaps by observing the relative quantities required to unharden a standard sample of water—an inversion, in fact, of Clarke's water-test. The proposed method takes for granted (tacitly, at least) that the most caustic soap (*i.e.*, the one containing the largest amount of alkali) is necessarily the best—a totally false assumption. A soap may be bad from presence of sophistications, from imperfect saponification, or from either excess or deficiency of alkali; and it is called good only when, in addition to being genuine and thoroughly "cooked," it contains alkali and fat duly balanced, such balance varying according to the purpose in view. Professor Schulze's test might place an adulterated but caustic soap upon the same level with one genuine but mild, or might even lead us to prefer the former.—J. W. SLATER.

Fermentation of Sugar.—(Answer to John Bowring.)—Alcoholic fermentation, upon which you have fixed your ideas, is not the only fermentation of the sugar-refinery, lactic and acetic fermentations being quite as prevalent. My experience does not enable me to say

whether hydric sulphide actually *produces* fermentation of either kind in sugar solutions, but it most unquestionably *favours* fermentation. You surely do not require instructions for the preparation of hydric sulphide. You seem to forget that the sulphide referred to is generated *in* the solution, not introduced after having been generated in a separate apparatus.—W. A.

Estimating Manganese by Bunsen's Method.—The following note has been sent us by Mr. Edward Sherer, as an addition to his paper "On the Estimation of Peroxide of Manganese in Manganese Ores" (CHEMICAL NEWS, vol. xx., p. 304). He there stated that in estimating the manganese by the method of Bunsen, the iodine solution gave higher results after standing twenty-four hours than before. He now adds:—These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid, set free by hydrochloric acid, distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 8 per cent of peroxide of manganese when titrated with hyposulphite.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 31st.—Medical, 8.
—— London Institution, 4.
TUESDAY, Feb. 1st.—Royal Institution, 3. Prof. Humphry, "On the Architecture of the Human Body."
—— Institution of Civil Engineers, 8
WEDNESDAY, 2nd.—Society of Arts, 8.
—— Pharmaceutical, 8
THURSDAY, 3rd.—Royal Institution, 3. Prof. Odling, "On Chemistry."
—— London Institution, 7.30.
—— Royal, 8.30
—— Chemical, 8
—— Royal Society Club, 6.
FRIDAY, 4th.—Royal Institution, 8. Mr. Ruskin, "On Verona and its Rivers."
—— Geologists' Association, 8.
Saturday, 5th.—Royal Institution, 3. Mr. Scott, "On Meteorology."

TO CORRESPONDENTS.

*** Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

ERRATUM.—The Lat. N. of Nantes was stated in our last number to be about 46° instead of 47° 13′ N.

W. L.—You had better advertise for the information you require.

J. W. Slater.—Received with thanks.

Pb.—We are not aware of any method which will practically separate lead and zinc on the large scale other than those contained in Crookes and Röhrig's "Metallurgy," which you quote. A method of separating small quantities of lead from much zinc, without having recourse to the costly subsidence method used at Vielle Montagne, would be of the highest importance.

BOOKS RECEIVED.

The Year-Book of Photography and Photo News Almanac for 1870. Edited by G. Wharton Simpson, M.A., F.S.A. London: Piper and Carter.

Our Domestic Fire-Places. A New Edition. By Frederick Edwards, jun. London: Longmans, Green, and Co.

The Body and its Health, for Primary Schools. By E. D. Mopother, M.D. Second Edition. Dublin: John Falconer.

Second Annual Report of the Committee of the Manchester National Society for Women's Suffrage.

Notes for Students in Chemistry, Being a Syllabus of Chemistry and Practical Chemistry. By Albert J. Bernays, Ph.D., F.C.S. Fifth Edition. London: John Churchill and Sons.

A Manual of Qualitative Analysis. By Robert Galloway, F.C.S. Fifth Edition. London: John Churchill and Sons.

Now ready, in crown 8vo., price 6s. cloth.

On Food; its Varieties, Chemical Composition, Nutritive Value, Comparative Digestibility, Physiological Functions and Uses, Preparation, Culinary Treatment, Preservation, Adulteration, &c. By H. LETHEBY, M.B., M.A., Professor of Chemistry in the College of the London Hospital, and Medical Officer of Health and Food Analyst for the City of London.

London: Longmans, Green, and Co., Paternoster Row.

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The Session 1869—1870 will commence on the 4th of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

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THE CHEMICAL NEWS.

VOL. XXI. No. 532.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 37.)

VIII. CHAR "DISEASES."

THE "diseases" to which animal charcoal is subject are very varied in their nature, and proceed from widely different causes. Upon this subject some very erroneous ideas are entertained by many of our refiners, as well as by scientific men. The manner in which certain specifics have been recommended and employed, with a view to cure almost every variety of "disease," testifies to the truth of the assertion. It is the writer's intention in this note briefly to notice the several diseases which have come under his own observation, and with the cause and cure of which he has had more or less to do.

1. *Deficiency of Carbon.*—This is a very serious defect, and one much more prevalent than might be supposed, considering that, in certain classes of refineries, the carbon increases, rather than diminishes, by continued use. A good working char should contain from 9 to 11 per cent of carbon; when it falls below 9, some agency is at work which ought at once to be enquired into. Faulty slides or joints will be admitting air to the ignited char in the kilns or coolers: or the system may be such that the char has to pass through the air on its way from the kilns to the coolers: in either case, a portion of the carbon is oxidised, and the proportion consequently reduced. Or the re-burning may be conducted at too high a temperature, a reaction taking place, in consequence, between the carbon and water—the latter being decomposed, and compounds of the former formed; or, further, deficiency of carbon may arise from the use of sugars containing large proportions of sulphates and sulphites, as indicated in Note III. The cause discovered, the cure is simple—have the kilns repaired, or renewed; re-burn at a more moderate temperature; avoid the use of sugars impregnated with sulphates and sulphites. Of course, attention to these points cannot restore the carbon already gone, but will prevent a further reduction of this valuable agent; the carbon may, indeed, increase, but it is questionable whether the increase will improve the quality of the char. The want of carbon is one of the worst diseases incident to animal charcoal—the reduction of that agent from 9 or 10 per cent to 6 or 7 means a reduction in decolourative power very much greater than these figures indicate; the preservation of the carbon ought, therefore, to be a special study of the refiner. The writer has before him at the present moment a sample of char from a working stock of several hundred tons, containing under 5 per cent of carbon; how a refinery with such a char stock can yield a profit to the refiner is more than he can guess.

2. *Excess of Carbon.*—As already indicated, the carbon usually increases by continued use; in some refineries, this increase is rapid and great, so great, indeed, as to amount to a "disease." This disease may arise from defective washing, or from the use of water containing considerable quantities of vegetable matter. The deposit of carbon, by the decomposition of organic matter in the process of re-burning, clogs up the pores of the char, just as any other impurity does; its injurious action ends there, however, having no active deleterious action in itself, as some other impurities have.

3. *Oxide of Iron.*—The presence of this agent in any considerable quantity may well be considered a "disease": it is most injurious and potent in its action. The faintest trace of iron in the refined product at once manifests itself on the addition of tannic acid or tea; and so injurious to the commercial value of the sugar is the presence of even the minutest quantity of that agent, that its avoidance is worth any expenditure of care and cash on the part of the refiner. Iron may accumulate in char from various causes.—in the process of re-burning there is, no doubt, a slight and unavoidable increase, but, with care, this need not be serious; if, however, defective kilns and careless manipulators are employed, this may prove a very fruitful source of iron. Here, therefore, is another inducement to the refiner to attend to the careful maintenance of his re-burning apparatus. But a more general source of iron is to be found in the action of sour or acid "washings," "scum-waters," &c., upon unpainted or defectively painted cisterns, moulds, &c. These "washings" impregnated with iron are used in dissolving raw sugars, or are concentrated and run through fresh char; a portion of the iron is extracted by the char and is ready to be given up to the first acid liquor that follows. There is thus a constant addition and abstraction of iron, which become about equal when about 0·7 per cent of oxide has been incorporated with the char. A thorough system of painting, with the avoidance of acid liquors, waters, &c., as far as practicable, is recommended. A portion of the iron may be removed from char suffering from this disease by the use of dilute hydric chloride and some other agents; but, as this subject wil be treated of in a separate note, it need not be the subject of further remark here.

4. *Lime.*—Accumulations of this agent in the pores of the char reduces the potency of the char as a decolouriser, and may otherwise injuriously affect the sugar liquors passing through it. This is not a disease very common in this country—at least, not to any serious extent. Several refiners, fancying their char was loaded with this agent, have expended large sums upon curative processes, but generally to no purpose, as the lime was more usually found to be deficient than excessive. Beanes's most admirable process for the removal of lime from char has, to a certain extent, failed in this country—not from any defect in the process, but from a want of the material to operate upon. A more ingenious and trustworthy process *for the removal of excess of lime* could not well be devised; and, on the Continent, where lime rapidly accumulates in the char in the process of refining "beet," the patent process would yield most excellent results. The writer has, on more than one occasion, had cause to feel surprise at statements made about Mr. Beanes's system, especially by chemists. It was defective because you could not wash the char free from acid; could not regulate the supply of gas to the requirements of the char; and other statements have been made, which simply show that the process was never understood by the parties making them. The process is free from all such objections, and, where lime exists in such excessive proportion as to render its removal desirable, no fear need be entertained with regard to the application.

5. *Overburned Char.*—Char that has been repeatedly overburned contracts—shrivels up, so to speak; the pores become smaller, or cease to exist. This is a serious defect, and one which cannot be remedied.

6. *Glazed Char.*—The glazing of char has been attributed to several causes by different writers; but the author although he has given some attention to the subject is by no means satisfied as to the real cause or causes. Friction may have something to do with it; but this is not the initial cause: defective washing will be more likely to account for it. That glazing is injurious to the char is beyond question: when chars become very highly glazed, their decolourative power is more or less reduced.

7. It is only necessary to indicate that two or more of the above diseases may obtain at the same time, and that complication of diseases renders successful treatment very difficult of attainment.

(To be continued).

ON THE TECHNICAL ANALYSIS OF SOAP.*

By M. GASTON TISSANDIER.

THE name of soap is given to true salts formed by combining fatty acids (oleic, margaric) with alkalies, such as soda or potash. The quality of a soap is ascertained by determining the proportion of fatty acid and alkali which it contains, and also the foreign substances—such as chlorides, alkaline sulphates, moisture, &c.—which always occur in varying proportions.

Fatty Acids.—Dissolve 5 grms. of the soap in question in ½ a litre of distilled water heated in a porcelain capsule; when dissolved, add a slight excess of dilute sulphuric acid, and let it boil for some minutes, so that the fatty acids may become separated and float upon the liquid. To weigh the fatty acids, cool them, and they will form a cake of grease, which must then be fused, in order to dry them, in a small tared porcelain capsule; this capsule, when again weighed, will give the amount of fatty acids corresponding to 5 grms. of soap.

Wax may also be used to facilitate the weighing. After the first part of the operation has been performed, and the fatty acids are floating, add 7 grms. of white wax, which will melt and mingle with them; cool the whole, take out the cake of wax, and weigh it, previously drying it between double filtering papers. The excess of weight gives the proportion of fatty acids.

Ash,—Soda.—Calcine, at red heat, 5 grms. of soap in a platinum capsule. Weigh the ash thus obtained, and dissolve it in 200 c.c. of distilled water; determine the proportion of soda in 100 c.c. by means of normal sulphuric acid (alkalimetric standard), evaporate to dryness, and notice the action of bichloride of platinum upon the residue dissolved in water, to ascertain whether it consists of potash or soda. The estimation of the soda may be verified by directly taking the alkalimetric standard of the soap (5 grs.).

Chloride of Sodium.—Estimate the chlorine in 50 c.c. of the solution with the standard silver solution.

Sulphate of Soda.—The sulphuric acid is estimated in the remaining 50 c.c. of the solution with chloride of barium.

Non-Saponified Fatty Bodies.—These also occur in soap, and may be detected as follows:—Dry 5 grms. of soap at 110°, after which treat it with common ether. Agitate it with that liquid in a flask, filter it, wash with ether, and evaporate the solution at 100°; the residue will be the non-saponified fatty bodies. The ether may, perhaps, dissolve a little of the soap; it must, therefore, be ascertained that the residue is really fat—melt it, and try whether it will soil glazed paper.

Non-Saponified Carbonate of Soda.—Cut 5 grms. of soap into small fragments, and treat them with boiling alcohol, which does not dissolve carbonate of soda. Filter, and treat the insoluble residue with alcoholic acetic acid, which dissolves the carbonate of soda without acting on the sulphate of soda and chloride of sodium. The acetic solution, evaporated to dryness and calcined, leaves, as a residue, carbonate of soda. Weigh it, and, if verification be required, take its alkalimetric standard.

Glycerine.—Dissolve 5 grms. of soap in boiling water, decompose it with dilute sulphuric acid, and separate the isolated fatty acids by decantation. The liquid, which is completely neutralised by the carbonate of soda, is now evaporated to dryness over a water-bath at 100° C.; the residue, composed of sulphate of soda and glycerine, is taken up by alcohol, which dissolves only the latter; it is then filtered and evaporated to dryness, when the residue will be glycerine. This is again taken up by alcohol, re-evaporated, and the residue again weighed, after ascertaining that it possesses all the properties of glycerine.

Water.—Cut the soap into thin slices; weigh 5 grms., and dry them on a stove at 120° C.

Composition of Various Kinds of Soap.

Substances estimated.	I.	II.	III.	IV.
Water	46·12	24·76	17·55	14·09
Soda	4·98	7·30	8·48	9·01
Fatty acids	37·99	64·50	71·45	74·68
Chloride of sodium	6·30	3·12	2·12	2·00
Sulphate of soda	0·72	0·32	0·40	0·22
Fatty bodies	1·00	—	—	—
Glycerine	2·89	—	—	—
Total	100·00	100·00	100·00	100·00

* *Moniteur Scientifique.*

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 39).

THE subject of drawing materials is of some little importance, and, as it is not treated upon in any microscopical work, a few remarks may not be out of place.

Probably no material is capable of representing elaborate microscopical subjects with so much truth as *water-colour*. When used with all the appliances of the modern school of painting, both colour and texture can be very closely imitated by skilful artists; but few have turned their attention to this subject; and, as the process is costly and not easy to acquire without a considerable amount of study, the use of this mode of representation will, in all probability, be very limited. Those who possess the requisite skill are strongly recommended to make use of it. Even as pictures, groups of aquatic animals and plants are quite as beautiful, both in form and colour, as flower compositions; and no other means of delineation, excepting the still more difficult art of oil-painting, can approach the truth of a highly-finished water-colour drawing. Unfortunately, at present, no means exist of re-producing these beautiful pictures, as their extreme delicacy places them beyond the powers of chromo-lithography.

The effect of outline sketches is much improved by the judicious employment of tints of water-colour; and this is by no means a difficult process, as it is a mere matter of laying on colour; while, in painting proper, quite as much is done by taking off paint as by putting it on, and also every advantage taken of the texture of both paper and pigment.

Pencil drawing is particularly useful for microscopical purposes. Fine lines can readily be made, and the shading is capable of much refinement, so that very delicate tissues can be faithfully delineated. Unless the drawing consists entirely of fine lines without shaded tints, the use of hot-pressed or perfectly smooth paper is not to be recommended, but one having a small, fine grain is to be preferred. The paper should always be supported behind on some hard substance, otherwise the pencil-point will cut in, the line be difficult to rub out, and also much of the power of guiding the pencil lost. For delicate

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

drawings, a piece of thick plate-glass makes an admirable drawing-board. The blocks or solid sketch-books so much used in out-door sketching, when made of a suitable paper, are particularly pleasant and convenient to draw upon. For shading, the pencil should not be cut to a sharp point, but rather kept square. Those with extra thick leads (such as BBBB and EHB) may sometimes be used to advantage, and even the broad, flat crayons known as Harding's tablets. For general outlining with camera or ruled disc, HB, from its freedom, will be found useful. For a fine outline, H should be used. Delicate tints may be obtained by rubbing on black-lead powder with a leather stump; the most convenient is that known as "Harding's." The author has found no black-lead pencils equal to those made by Mr. B. S. Cohen; they are very even in texture, rub out easily, do not readily break, and correspond exactly with the irrespective marks. The 6 H, made for drawing on wood for engraving, is well adapted for the purpose for which it is intended.

Pencil drawings, and also those in chalk and charcoal, may be permanently fixed by applying freely at the back until the paper is saturated a varnish composed of white (bleached) shellac, made by mixing equal parts of white lac-varnish and methylated spirit. The white lac-varnish is always supplied by Messrs. Winsor and Newton of uniform strength, and will save the trouble and difficulty of dissolving bleached lac. The drawing is to be carefully dried before a fire, and, when completed, may be rubbed with india-rubber with perfect impunity. Water-colour may be freely used in combination with pencil, as it is not affected by this varnish, which does not stain the paper when dry, although it soaks in when first applied, and renders it transparent like oil.

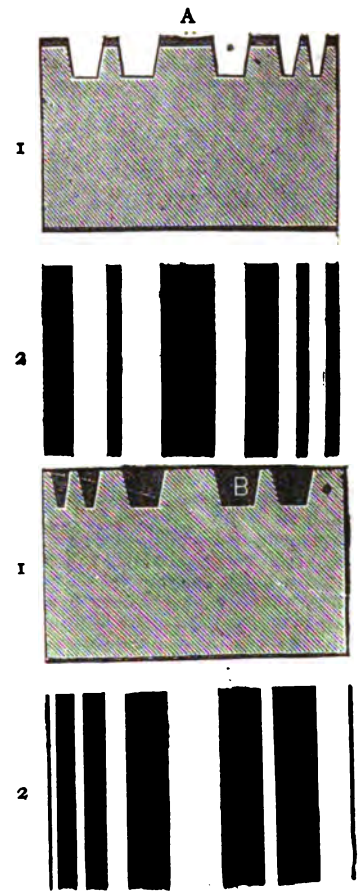
The multiplication of microscopical drawings is a subject worthy of the attention of every observer. With the exception of Dr. Beale,* no writer on the microscope has given any account of the various processes of engraving; and yet, unless the microscopist can command the services of the very few engravers and lithographic artists who have devoted themselves to the re-production of microscopical subjects, there is, as the author has found by experience, great risk of misinterpretation.

Photography is capable of copying drawings with great exactness, and has no fault saving its cost. When only a small number are required, it would probably, however, be cheaper than any of the printing processes.

The printing processes proper consist of plate and surface printing and lithography.

Copper and steel plate engraving consist of cutting lines in a metal plate with a pointed steel tool of square or rhomboidal section, known as a graver. The plate, when finished, is rubbed over with a thick printing-ink, which is afterwards cleaned off, leaving the lines full (Fig. 45 B, 1). The plate is then passed through a powerful rolling-press with a sheet of thick, porous paper over it, which is forced into the lines, and takes the ink out of them, forming the impression (Fig. 45 B, 2). Instead of excavating the lines with a cutting tool, the plate may be covered with a preparation capable of resisting acids, known as etching-ground. The copper is then laid bare by scratching through the ground with a suitably-mounted needle. Diluted nitric acid is poured on the plate, and allowed to corrode the metal. When sufficient depth is obtained, the acid is poured off. Those lines which are "bitten" sufficiently are filled up with varnish. The process of biting is then repeated until the deepest lines are sufficiently corroded. This process of *etching* is a great favourite with artists, and might, no doubt, be turned to account for microscopical purposes, as it is much easier than using the graver, which is a very troublesome tool. The disadvantage of plate printing is that the obtaining of impressions is expensive, and the number limited, owing to the rapid wear of the plate; this latter objection, however, may be overcome by copying the plate by electrotype. The variety of engraving known as mezzo-tint is well adapted for the representation of tissues; but it requires a skilled engraver, and the learning of it would take up too much of the observer's time.

FIG. 45.*



Surface printing is the reverse of plate printing. In this, as will be seen (Fig. 45, A, 1), the light parts are excavated and the dark parts left standing; these receive the ink from the roller, and yield a copy to a sheet of paper upon pressure being applied (Fig. 45 A, 2). Common type is an example of this kind of printing. For art purposes, wood engraving is employed. The drawing is made on a block of box-wood, which is then placed in the hands of the engraver, who cuts away the light portions, leaving the solid black (if

* "How to Work with the Microscope," pp. 28—35.

* We are indebted for this woodcut to Messrs. Winsor and Newton.

any) standing, and variously modifying, by lines and dots, the portions which have a tone between black and white "half-tints." The process is a difficult one, requiring great skill, which is only to be acquired by very long practice. It is capable of rendering microscopical subjects with great perfection: the re-productions of Dr. Beale's drawings in his various papers, by Miss Powell, are marvels of delicacy. Some beautiful specimens of wood-engraving will also be found in the work on the microscope by the late Richard Beck. Wood-engraving has the advantage of being cheaply printed, and also of being set up along with type, although, in the latter case, its beauty is somewhat sacrificed: it never has justice done to it unless it is printed by itself, and with very great care. A valuable little book on the "Art of Wood-Engraving," by T. Gilks, is published by Messrs. Winsor and Newton.

(To be continued.)

ON THE

ACTION OF BROMINE UPON ETHYLBENZOL.*

By T. E. THORPE, Ph.D.

In the course of an investigation upon ethylbenzoic acid, which Professor Kekulé and the author recently published, they had occasion to prepare a quantity of monobromethylbenzol, $C_6H_4Br\{C_2H_5$, the object being to prove, experimentally, the identity of the ethylbenzoic acid made synthetically by acting upon monobromethylbenzol by means of carbonic anhydride and sodium, with the acid subsequently obtained by Fittig by oxidising diethylbenzol by means of nitric acid. The authors, while preparing the bromide they required for their experiments, followed the directions given by MM. Fittig and König: The action of bromine upon ethylbenzol is very energetic, and the last-named substance has to be strongly cooled. The resulting product was submitted to fractional distillation; at 145° the liquid commenced to boil, and a comparatively large quantity passed over between 150° and 160°; but the greater portion came over between 180° and 190°. An analysis of that portion showed it to contain very nearly the theoretical amount of bromine calculated for C_8H_9Br; this compound is very unstable. On renewed distillation, it was found to begin to boil at 140°, and, unless the distillation is very rapidly conducted, a large proportion is transformed into styrol and hydrobromic acid; this difficulty is met, however, by distillation *in vacuo*. The bromide thus obtained is a heavy colourless liquid, boiling nearly constantly at 148° to 152°, and possessing a characteristic penetrating odour. When heated with solutions of ammonia or potassa in alcohol, it gives up its bromine with the greatest facility. The author points out the very great difference of properties discovered by him to exist between the monobromethylbenzol described by M. Fittig and that obtained by him and just alluded to, and reasonably concludes that these substances, although prepared under conditions apparently exactly similar, are not identical. The compound obtained by the author is identical with that obtained by Berthelot by acting upon boiling ethylbenzol with vapours of bromine, and the formula of that substance is $C_6H_5\{C_2H_4Br$.

The larger portion of the contents of this paper is further devoted to the description of the experiments made to discover the cause of the variation in the position of the bromine atom. As the result of these experiments, some new substances were obtained; among these, styrolyl-ethyl-ether, a colourless, mobile, fragrant smelling liquid, boiling constantly at 187° (sp. gr. at 21·9°, 0·931), slightly soluble in water, and burning with a strongly-luminous flame.

The author describes, at great length, the different operations and manipulations applied by him, but space forbids us to enter into more details on this subject.

* Abstract of a paper communicated to the Royal Society.

ON THE

SUPPOSED NUCLEATE ACTION OF WEAK SOLUTIONS OF GLAUBER'S SALT ON SUPERSATURATED SOLUTIONS.

By CHARLES TOMLINSON, F.R.S.

A GENTLEMAN, under the signature of "A Constant Reader of the CHEMICAL NEWS," has written to me respecting my theory of the action of nuclei on supersaturated solutions,* and states that this theory does not meet the case given by M. Jeannel,† in which a supersaturated solution (say of Glauber's salt) filtered into a flask, is protected by leaving the funnel and the filter in the neck of the flask; so that when cold, an ordinary solution of the same salt being poured upon the filter, produces crystallisation as soon as it reaches the supersaturated solution.

The objection is—(1) that, in such a case as this, there can be no nucleus derived from the air, and (2) that the liquid which causes the solution to crystallise is chemically clean.

While engaged in studying the subject of supersaturated solutions, I read M. Jeannel's paper with much interest, and repeated his experiments with such variations as the nature of the case seemed to require. My conclusion was that, if the experiment be conducted with proper attention to cleanliness and care to exclude nuclei, a solution of Glauber's salt may be allowed to fall upon a cold supersaturated solution of the same salt without inducing crystallisation.

So long as I adopted M. Jeannel's form of experiment, I always obtained his result—namely, a separation of the salt from the supersaturated solution. But this form is objectionable, because, by leaving the funnel and filter exposed during many hours to the air, active nuclei become accumulated on it, and some of them are sure to be dragged down with the solution into contact with the contents of the flask. In like manner, a crystal taken up between the finger and thumb, or even by mere exposure to the air, is said to be an active nucleus in crystallising a supersaturated saline solution of its own kind; but I have already proved‡ that, if care be taken to make the crystal chemically clean, it is possible to bring it into contact with a highly-supersaturated solution, and to leave it there for days, and even months, without any separation of the salt.

M. Jeannel's position is that drops of a solution of a salt, allowed to fall upon a supersaturated solution of the same salt, will cause it to crystallise. In testing such a proposition, I am, of course, allowed to adopt my own means for conveying the drops to the solution, and, provided they reach it and fall upon it, the case is met, even though the funnel and filter be dispensed with.

My method of conducting the experiment was this:—A solution of Glauber's salt was filtered into a clean flask, in which it was boiled up again; and, while boiling, a clean, straight dropping-tube, closed by means of a cork at the top, and passing through a disc of vulcanised india-rubber, was put into the flask, so that its point dipped below the surface of the solution. The heat expanded the air of the tube, and a considerable quantity of it

* CHEMICAL NEWS, vol. xix., p. 267.
† *Ann. de Ch. et de Ph.*, 4 Ser., t. vi., p. 166.
‡ CHEMICAL NEWS, vol. xviii., p. 110.

escaped in bubbles. When the lamp was removed, an equal volume of the solution entered the tube, which was then pulled up about an inch, so as to be out of, but over, the solution. The india-rubber disc protected the solution from the entrance of nuclei, but, as a further precaution, each flask was covered with a bell-glass. In this way, the solutions can be kept as long as may be required without crystallising. On taking off the bell-glass and gently loosening the cork (a stop-cock would have been better), the solution fell from the tube in drops, but there was no separation of salt.

Two solutions were next made, the one containing 1 part of salt to 1 of water, and the other 2 parts of salt to 1 of water. Each flask contained a tube, passing through an india-rubber disc, as before; and, when the tubes had taken up a quantity of the solution, they were changed—that is, the tube containing 1 salt to 1 water was put into the flask containing 2 salt to 1 water, and *vice versâ*. When the solutions were cold, the corks were loosened. The drops produced much disturbance in the internal viscosity of the solutions, but there was no crystallisation.

In another experiment, the solution containing 1 salt to 1 water was allowed to drop into a solution containing 3 salt to 1 water, and this into the solution of 1 salt to 1 water. The solutions were prepared over night, and, as the night was cold, the flasks, as well as the tubes, contained portions of the modified salt, so that crystals, as well as drops fell into the solutions; but still the solutions did not crystallise: on taking out the tubes, they did so immediately, the nuclei being, of course, derived directly from the air.

A still weaker solution (namely, 1 salt to 3 water) was allowed to drop into a supersaturated solution containing 2 salt to 1 water; but there was no separation of salt.

Hence it will be seen that, if proper precautions be taken to exclude nuclei, a solution of Glauber's salt does not act as a nucleus to a supersaturated solution of the same salt.

Supersaturated solutions of potash-alum, treated in the same way, lead to the same result. I have no doubt that similar solutions of other salts would lead to the general conclusion that solutions of salts do not act as nuclei to their supersaturated solutions.

Highgate, N., Jan. 29th, 1870.

ON THE

DECOMPOSITION OF SALTS OF SESQUIOXIDE OF IRON.

By M. H. DEBRAY.

If a solution of neutral chloride of sesquioxide of iron, so much diluted that its colour is scarcely perceptible be heated, the liquid will be seen, after arriving at 27°, to become strongly coloured and assume the characteristic hue of sesquioxide of iron. This change is not owing to the evolution of a certain quantity of chlorhydric acid, for it is effected in close vessels, and, after cooling, the liquid retains its primitive acid reaction and the colour which it has received from the heat.

The chemical properties of the salt of iron are greatly modified: the original liquid gives with yellow cyanide a precipitate of a deep Prussian blue colour, whilst the coloured solution with the same reagent yields only a pale greenish blue precipitate, and saline solutions of sea-salt for instance, without acting on the ordinary chloride, produce in the modified chloride a gelatinous precipitate of hydrated sesquioxide of iron. This oxide when immediately washed re-dissolves in the water and contains only small quantities of salt, but it loses the property of solubility if it be allowed to digest a day or two with its precipitant. The modified solution when dialysed gives chlorhydric acid almost entirely exempt from iron, which passes through the paper and from soluble oxide of iron which remains in the dialyser.

The chloride of iron separates at about 70° into chlorhydric acid and sesquioxide of iron, soluble in water and in diluted chlorhydric acid, insoluble in most saline solutions: these are precisely the characteristics of colloidal oxide of iron obtained by Mr. Graham in the dialysis of basic solutions of iron.

It is not supposed that chloride of iron separates into chlorhydric acid and basic chloride, because the existence of these basic soluble compounds appears scarcely reconcilable with the fact of their decomposition by the septum in dialysis, or by the sea salt which precipitates pure oxide of iron.* It would seem more natural to consider these compounds as solutions of colloidal oxide of iron in chlorhydric acid, or, at least, in common sesquichloride of iron.

On heating on a water-bath at 100° a diluted solution of sesquichloride of iron, and carefully replacing the evaporating liquid, the soluble oxide is gradually changed into the isomeric modification of sesquioxide of iron discovered by Pean de Saint-Gilles. It will be remembered that this chemist by subjecting acetate of sesquioxide of iron in solution to the prolonged action of heat obtained a particular oxide insoluble in dilute mineral acids and in most alkaline solutions, and yielding, when mixed with water, a liquid transparent to transmitted light and turbid on reflection.

Some years later, M. Scheurer-Kestner demonstrated that the decomposition of nitrate of iron would also furnish it. According to my experiments, the production of Pean de Saint Gilles's oxide is due to the same cause. The first effect of heat upon salts of iron with monobasic acid is to separate them into acid and oxide, which only remain separate if the acid is diluted; the next is to transform the soluble oxide into the metasesquioxide of Pean de Saint-Gilles, which differs by its state of hydration and by several of its characteristics from the colloidal oxide of Mr. Graham. Solutions of bibasic acids, like the sulphate, yield only insoluble subsalts when submitted to the action of heat.

If De Senarmont's method be used, namely, by decomposing chloride in a diluted solution at a temperature varying from 250° to 300°, at which colloidal oxide and metasesquioxide no longer exist, the separation of the acid and oxide necessarily occur, since a temperature of 70° only suffices to effect it. The oxide, which is produced very slowly, is anhydrous sesquioxide and crystallised, that is to say, oligistic. It is unnecessary to explain the experiment of De Senarmont to introduce the influence of pressure upon the closed tube in which the experiment is made by steam strongly heated, or by an evolution of chlorhydric acid.

Iron may be separated from manganese by a well-known method, as follows:—First transform the metals into chlorides; then bring the iron to the maximum of oxidation; and, after incompletely saturating the excess of acid by carbonate of soda, an excess of acetate of soda is added to the boiling liquid. The sesquioxide of iron is precipitated alone in the acid liquid. The theory of this reaction is very simple. The acetate of sesquioxide of iron, formed of a mixture of chlorides and acetate of soda, separates, on boiling, into acetic acid and colloidal oxide, insoluble in a liquid containing a notable quantity of sea-salt and acetate of soda. When washed quickly in cold distilled water, a large portion of the oxide re-dissolves; this may be avoided by washing it with a diluted solution of chlorhydrate of ammonia. It will also be easy to introduce into the liquid containing the chlorides only volatile reagents, acetate of ammonia, which produces the same effect as acetate of soda, because colloidal oxide of iron is insoluble in an ammoniacal salt, even in the

* This reaction of alkaline chlorides on basic chlorides was noticed for the first time by M. Béchamp (*Ann de Ch. et Phys.*)

presence of a large quantity of acetic acid. The separation of oxides of iron and manganese is as perfect as possible by this method; but it is preferable for exactitude in weighing the oxide of iron to pour the solution of acetate of ammonia into a hot solution of nitrates of the two bases, and to wash the oxide with a warm solution of nitrate of ammonia. The loss of iron consequent upon the action of the ammoniacal salt upon oxide of iron during calcination is thus avoided.

Aniline is actually prepared (after M. Béchamp's method) with nitrobenzol, iron, and a quantity of acetic acid much smaller than that of the quantity of sesquioxide formed. The acetate of peroxide of iron, having but little stability at the comparatively high temperature of the reaction, is decomposed into insoluble sesquioxide of iron, and into acid capable of again reacting on the metal. A small quantity of acetate of aniline should also be formed; but, if the tension of dissociation of this salt is sensible at the temperature of the experiment, it necessarily follows that a small quantity of acid will suffice to terminate the reaction.—*Comptes Rendus.*

ON THE SEPARATION OF IRON AND ALUMINA.

By E. W. PARNELL.

Of the many methods proposed for the separation of iron and alumina effectively, no one seems to combine the very necessary qualities of accuracy and simplicity. The method of weighing the two oxides together, and then separating the alumina by fusion with caustic soda and subsequent treatment with water, is, no doubt, exceedingly accurate, but troublesome. In an accurate analysis, an analyst avoids, if possible, volumetric estimations. The plan of effecting the separation of the iron by means of sulphide of ammonium from the ammonio-citrate solution of the oxides cannot give perfectly accurate results, since the sulphide of ammonium has the power of holding up small quantities of iron in solution; this may be proved by letting the perfectly-clear filtrate stand a few days, when small flakes of sulphide of iron will be deposited.

The method about to be described (proposed, I believe, by Prof. Bunsen, of Heidelberg) is in use in some laboratories on the Continent. I have never seen it published in English, and it may possibly be new to some of your readers. To the slightly acid solution of the oxides a solution of hyposulphite of soda is added, more than equivalent to the amount of free acid present. The liquid is then boiled in a flask for about ten minutes or a quarter-of-an-hour. The whole of of the alumina will be thrown down in a fine granular state, together with the sulphur resulting from the decomposition of the hyposulphurous acid; while the whole of the iron will remain in solution. The liquid is then rapidly filtered, and the precipitate washed with boiling water, dried, ignited in a porcelain crucible, and weighed in the usual manner. The filtrate containing the iron is treated with hypochlorite of soda, nitric acid, or other oxidising agent, and the iron estimated by precipitation by ammonia and weighing as sesquioxide. Care should be taken to avoid large excess of acid, in the first instance, and also, subsequently, of the hyposulphite: the smaller the proportion of sulphur with the precipitated alumina, the more easily may it be filtered off from the iron solution. After calcination, the alumina appears as a perfectly-white, crystalline powder, much resembling precipitated and calcined silica.

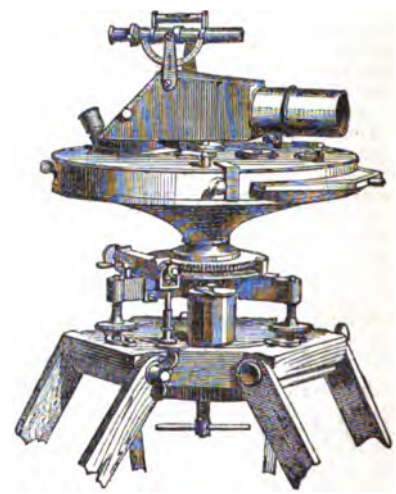
Alumina might probably be separated by this method from other metals—such as manganese, zinc, &c.; and, were phosphoric acid present, it would probably be carried down with the alumina. I have not, however, experimented on these points.

Runcorn Soap and Alkali Works,
Runcorn, Jan. 27th, 1870.

PHOTOGRAPHIC PLANE-TABLE.

We have received through the kindness of Mr. James Swaim, a pamphlet on the above instrument, invented by M. Auguste Chevalier, containing full descriptions of its working and construction, and illustrated by engravings and a photograph.

The accompanying woodcut represents an exterior view of the apparatus as given by the photograph. It consists of a photographic objective, behind which is placed a square prism, by total reflection from whose oblique rear surface, the image formed by the lens is projected upon an horizontal sensitive plate set beneath. The lens and prism, as well as an opaque screen covering the plate with the exception of a narrow slit in a plane passing through the axis of the lens and the centre of motion, rotate about a vertical axis in the middle of the instrument, being driven by appropriate clock-work. By this means, when the instrument is placed at one end of a base line, adjusted, furnished with a sensitive plate, and allowed to make a total revolution, it will produce an automatic photographic horizontal projection of all objects within the panoramic field, from which their various angular relations may be determined with the greatest accuracy. It might seem that sharpness of definition was incompatible with a continuous motion of the lens, but the admirable panoramic pictures produced by the apparatus of Martens and of Garella, which operate on the same principle, are a complete and satisfactory answer to this objection.—*Journal of the Franklin Institute.*



ON BAUME'S AREOMETER.

By M. BAUDIN.

Sundry divergences occur in Baumé's areometer, according to different authors. Upon examining this instrument, I found the figure given for 85 parts of distilled water and 15 parts of pure and well-dried chloride of sodium to be 1·111 absolute density at 15°. Francœur found 1·109; Soubeiran, 1·116; Terlach, 1·114; and M. Coulier, Professor of Chemistry, gives 1·110725. The work of the latter may be considered as the most important of those upon the subject.

Repeated experiments have convinced me that the figure of density 1·111 is most correct; I have, therefore, employed it to re-construct the actual scale of Baumé.

The figure 1·116, given by Soubeiran, does not correspond with Baumé's formula (85 parts of water and 15 of salt), and indicates that the instrument marks 66° in a sulphuric acid whose point of concentration is undefined: this arbitrary scale is by no means that of Baumé. Serious results arise from these discrepancies—manufacturers are uncertain as to which Baumé-areometer they should trust, and endless disputes ensue. Brisson's densimeter should be the only one employed, as anyone can manage it.

Comparison of Baumé's Scale (Acidimetric) with the Scale of Density.

Baumé. Degrees.	Francœur. Density.	Baudin. Density.	Soubeiran. Density.
0	1000	1000·0	1000
5	1034	1034·4	1036
10	1070	1071·3	1075
15	1109	1111·0	1116
20	1151	1153·8	1161
25	1196	1200·0	1210
30	1245	1249·9	1262
35	1299	1304·2	1320
40	1357	1363·5	1383
45	1420	1420·4	1453
50	1490	1500·0	1530
55	1567	1578·9	1615
60	1652	1666·6	1711
65	1747	1764·6	1819
70	1853	1875·0	1942

NOTICES OF BOOKS.

Our Domestic Fire-places. A New Edition, entirely Re-written and Enlarged, the Additions completing the Author's Contributions on the Domestic Use of Fuel, and on Ventilation. By FREDERICK EDWARDS, jun. London: Longmans, Green, and Co. 1870.

THIS work treats on a most important subject, since it is one of the more difficult things in domestic economy to utilise fuel well, and to derive from it the greatest benefit with the least expenditure of combustible matter.

The work before us is divided into four chapters, and to each of these are added a series of lithographed plates for illustration. The first chapter treats chiefly on the history of fire-places and the substitutes in use even at comparatively recent times. We find recorded at page 5 that, at as late a period as the end of last century, before the introduction into England of the system of heating by hot-water circulation and by close stoves, large areas (including the Chamber of the House of Commons) were heated by charcoal or coke, burned in the open brazier. The second chapter gives a short account of the improvements in fire-places which have been effected during the present century. The third chapter treats on the improvements to be still effected in the domestic fire-place, and on the means for better diffusing the heat of the open fire-place, and thereby avoiding inequalities of temperature in the apartment. Under this heading, eight sub-sections are introduced, viz.—(1) By using the best form of grate; (2) by using the most suitable materials for the construction of the grate; (3) by improving the fire-bars; (4) by using the fire within a chamber of firebrick and checking the supply of air from below; (5) by checking the escape of the warm air of the room into the chimney; (6) by giving a supply of air in proximity to the fire-place, instead of from doors and windows; (7) by doubly-glazing the windows—(As regards this particular, anyone acquainted with the Continent must wonder at the fact that the mansions and abodes of the better classes are not more generally provided with double windows: this is a very frequent occurrence on the Continent, and contributes largely to retain the heat generated by fire-places); (8) by utilising the heat which escapes from the chimney. The fourth chapter is entirely devoted to the description of stoves, caloriféres, and the various modifications thereof, and to such subjects as heating by hot water, hot air, and steam.

We regret that space forbids us to enter into even one or two of the many interesting details this work contains. It bears on every page the mark of careful research, and abounds to such an extent with useful matter that we should desire to see it studied and its contents brought into actual practice by all those who are in any way concerned with the important branch of domestic economy on which it treats.

As is usual with the eminent firm who published the work, its execution leaves nothing to be desired.

The Body and its Health; a Book for Primary Schools. By E. D. MAPOTHER, M.D., &c. Dublin: John Falconer. London: Simpkin, Marshall, and Co. Pp. 127.

IT is an excellent sign of the increased desire of knowledge such as is contained in this little book, as well as of the excellence generally speaking of its contents, that the first edition was, as we learn from the brief preface, sold off in three days. *De tous les capitaux celui dont le peuple est le plus prodigue est leur santé* was long ago said by an eminent French *savant*. Health is wealth; and whatever promotes the first is highly conducive to the latter. How can we expect the "*mens sana in corpore sano*" where that *corpus* is neglected through sheer ignorance?

This book is filled with really useful knowlege, and treats on subjects of the highest importance. We have here an epitome of anatomy, physiology, dietetics, and hygiene rendered accessible, and easily comprehended by the young readers it is intended for. Interspersed through the context, we meet with a great many brief facts relating to chemistry, which, since they are applied in a proper manner, are very useful; although on page 42, we think the reason given for the purity of sea and country air as being due to ozone, is one for the truth of which no sufficiently reliable data have as yet been found. Sea air undoubtedly contains some chlorine and always finely-divided, almost-pulverised salts. Country air owes much, if not all, of its purity to its freedom from dust and smoke, the effects of meadows, and trees, and growing crops; to the absence of high buildings, the lesser impediments of free circulation; and last, but not least, to freely-running brooks and water-courses.

The book is very well illustrated with a number of woodcuts; and it is not only excellent for the youth, but many full-grown people may be taught a useful lesson by its perusal.

The Pharmacopœias of the London Hospitals. By PETER SQUIRE, F.L.S. London: Churchill and Sons.

The Pocket Guide to the British Pharmacopœia. London: Hardwicke.

MR. SQUIRE'S well-arranged and capitally-printed book must prove of great service to the doctors. Arranged in groups for easy reference and comparison, it contains the pharmacopœias of seventeen London hospitals, and thus serves as a standard of the therapeutical practice of the present time.

The "Pocket Guide" seems to comprise the essentials of the "British Pharmacopœia," conveniently arranged in a small compass for the busy practitioner to carry handily.

CORRESPONDENCE.

COLOPHONIC HYDRATE.

To the Editor of the Chemical News.

SIR,—Observing in the CHEMICAL NEWS (vol. xx., p. 38) Mr. Tichbourne's account of colophonic hydrate, it may be worth while mentioning the result of an analysis which I made shortly before leaving England, in 1866.

Some white, needle-shaped crystals that had formed in an old sample of rosin-spirit were purified by sublimation and submitted to combustion. 0·112 grm. gave 0·239 CO_2 and 0·112 H_2O.

	Found.	$(C_{10}H_{16}+4H_2O)$.
Carbon	58·19	57·70
Hydrogen	11·11	11·53
Oxygen	30·70	30·77
	100·00	100·00

The crystals fused below 100° C. They were soluble in water and neutral.

I observed, about the same time, that crystals of a similar appearance quickly formed in rosin-spirit which had been distilled in a current of steam.—I am, &c.,

ALEXANDER M. THOMSON.

University, Sydney, N.S.W.,
Dec. 2nd, 1869.

REACTIONS OF DISULPHIDE OF CARBON WITH BARIC AND CALCIC HYDRATES.

To the Editor of the Chemical News.

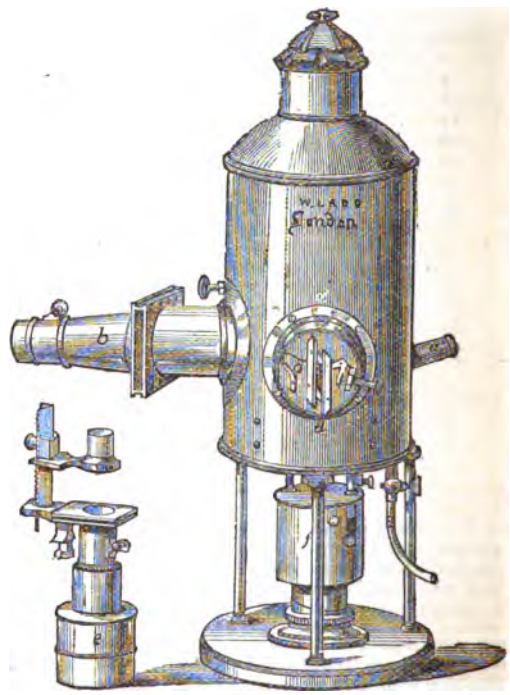
SIR,—In Watts's "Dictionary" (vol. i., p. 776) the reactions of disulphide of carbon with the fixed caustic alkalies are given, but those with baric and calcic hydrates are omitted, nor are they to be found in any of the addenda. I have, therefore, thought that perhaps the following notes might be worth insertion.

A solution of baric hydrate, agitated with carbonic disulphide, rapidly turns to a dark purplish brown colour, changing to a dirty green, and, lastly, to a brownish yellow solution with a small quantity of dark brown deposit, this final result being precisely similar to that obtained after a much longer period of time with sodic or potassic hydrate, as, in the time required to produce the purplish brown colour with the baric hydrate, a pale brownish yellow only could be obtained with the sodic or potassic hydrate. A solution of calcic hydrate with carbonic disulphide produces, after long stirring and standing, only a pale brownish yellow solution, a result to be expected from the inferior solubility of the calcic to the other hydrates. The reaction is, of course, similar in all cases, viz., the formation of carbonates and sulpho-carbonates.—I am, &c.,

HENRY MATHEWS.

MISCELLANEOUS.

Improved Electric Lantern.—Since spectrum analysis has been discovered a great inconvenience has been felt by lecturers in being compelled to use two lanterns—one for exhibiting the spectrum, and the other to project on the screen a direct ray of light, a photograph, or other object. When only one lantern was used it was requisite to disconnect the apparatus, and revolve the lantern in order to project the object on the screen, and as it has been found inconvenient to show all the spectrum experiments together, and diagrams, &c., afterwards, the loss of time in getting the prisms and lenses to their required position, and re-adjusting the lantern, is considerable. These inconveniences Mr. Ladd has entirely overcome by his new form of lantern, which is provided with two openings—one placed facing the screen, and the other at an angle of about 100° from it, this being about the proper angle when two prisms containing bisulphide of carbon are used for producing a spectrum. But as the angle must vary, according to the distance from the screen, one of the openings is provided with an adjustment for that purpose. The lantern is also provided with a small opening at the back, at the same height as the other two, for the reception of a sliding tube, carrying a lens at one end which focuses on a piece of ground glass at the other an image of the carbon



points. This enables the operator not only to see what is going on at the points, but also to keep them at an exact height, so requisite in many experiments. As an example of the utility of this arrangement, we will suppose the operator wishes to project on the screen an image of the arc as well as the spectrum of any particular substance; to do this he closes the slit, and focuses the arc by means of the optical arrangement facing the screen, and while the metal is still burning he closes this opening and opens the slit, when immediately a spectrum of the substance appears in the same part of the screen. The lantern is entirely of metal, and is also provided inside with a gas-jet and stopcock to enable the operator to perform his work in a darkened room.

Correlation of Vital and Physical Forces.—Preliminary trials having shown that any change of temperature within the skull was soonest manifested externally in that depression which exists just above the occipital protuberance, a pair of these little (thermoelectric) bars was fastened to the head at this point; and to neutralise the results of a general rise of temperature over the whole body, a second pair, reversed in direction, was attached to the leg or arm, so that if a like increase of heat came to both, the electricity developed by one would be neutralised by the other, and no effect be produced upon the needle, unless only one was affected. By long practice it was ascertained that a state of mental torpor could be produced, lasting for hours, in which the needle remained stationary. But let a person knock on

the door outside the room, or speak a single word, even though the experimenter remained absolutely passive, and the reception of the intelligence caused the needle to swing through 20°. In explanation of this production of heat, the analogy of the muscle at once suggests itself. No conversion of energy is complete; and as the heat of muscular action represents force which has escaped conversion into motion, so the heat evolved during the reception of an idea, is energy which has escaped conversion into thought, from precisely the same cause. Moreover, these experiments have shown that ideas which affect the emotions, produce most heat in their reception; a few minutes recitation to one's self of emotional poetry, producing more effect than several hours of deep thought. Hence it is evident that the mechanism for the production of deep thoughts, accomplishes this conversion of energy far more perfectly than that which produces simply emotion. From a Lecture by Professor G. F. Barker, before the American Institute, reported in the *Scientific American*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, January 17, 1870.

This number contains the following papers and memoirs relating to chemistry and allied sciences:—

General Theory of Chemical Action and the Necessity of its Introduction and Use to Prevent Errors being made.—M. Maumené.—This paper was read, but is not published. From an account of the meeting at hand, we learn that this very revolutionary chemical paper, containing direct attacks upon the most eminent living, as well as deceased, authorities of chemical science, has been remanded to the section for chemistry.

Dispersion of Light.—M. Ricour.—A continuation of a former paper on this subject, and strictly algebraico-physical.

Some Silicified Vegetables met with near Autun.—M. Regnault.

Nickelisation.—M. Gaiffe.—The author states, in a letter read at the meeting by M. Dumas, that he desires to call the attention of the members to a variety of objects electro-nickelised, sent to the place of meeting. He also calls attention to the fact that the presence of even the smallest quantity of potassa, or soda, or alkaline earths in the bath containing the nickelising preparation is injurious to effect a properly-adhesive coating of the metal. The use of perfectly pure double chloride of nickel and ammonium, or of perfectly pure sulphate of nickel and ammonium, and, moreover, of pure nickel, as one of the electrodes is required. By these means, the nickel is made to adhere regularly and strongly, and only requires polishing after the metal coated over is taken from the bath.

Spectra of the Simple Gases.—M. Wüllner.—This paper is a defensive reply from the author against the remarks made by M. Dubrunfaut on his former paper concerning this subject.

Synthesis of Normal Propylic Alcohol by means of Ethylic Alcohol.—M. Rossi.—The author converts chloride of ethyl into cyanide of ethyl, and next converts that cyanide, by means of well-known methods, into propionic acid. From the lime-salt of that acid propionic aldehyde is obtained; this is a clear, very mobile liquid, soluble in water, exhibiting a suffocating odour, boils at 49·5°; at 740 m.m. barom., sp. gr. at 17°, 0·804; formula, C_3H_6O. By hydrogenising this aldehyde, the propylic alcohol is obtained. After having been purified, this liquid exhibits the following properties:—Boils at 96°; barom., 743 m.m.; sp. gr. at 0°, 0·8205; formula, C_3H_8O. The author describes, at some length—Bromide of propyl, C_3H_7Br; iodide of propyl, C_3H_7I; cyanide of propyl; acetate of propyl—

$$\left.\begin{matrix}C_3H_5O\\C_3H_7\end{matrix}\right\}O.$$

January 24, 1870.

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

Electro-Depositing of Nickel upon Other Metals.—M. Becquerel.—Eight years ago, the author applied, for the purpose of electro-deposition of nickel upon other metals, the same method as described at the previous meeting by M. Gaiffe and his associates. M. Becquerel now states that, since the last meeting, he has purposely repeated some of his former experiments, with the express view of ascertaining whether the statement made by M. Gaiffe, concerning the injurious action of the presence of potassa be correct or not. The result of experiments is that the presence of potassa is not at all injurious to, and in no wise affects, the deposition of nickel, since the double sulphate of nickel and potassa can be applied, as well as the double sulphate of nickel and ammonia; but if the positive electrode is not made of nickel, it is necessary to add free ammonia, in order to saturate the sulphuric acid which is set free.

Election of a New Corresponding Member.—M. Kirchhoff has been elected corresponding member, in lieu of Mr. Forbes, deceased.

Discovery of Diamond at Diaschkowitz (Bohemia).—M. Schafaritz.—At 60 kilometres (37·26 English miles) north-west from Prague, in a mining district belonging to Count Schönborn, a stone was found a few weeks ago, which, on having been forwarded for assay to the Polytechnic School at Prague, turned out to be a diamond. Its weight is 57 milligrms.; sp. gr., 3·52; its shape, irregular; its crystalline form, a rhomboidal dodecahedral. This discovery is interesting in more than one respect—in the first place, this specimen is the first genuine diamond found in Europe (the Ural mountains produce diamonds, but not on European territory); secondly, because of the geological formation wherein this specimen occurred, a formation quite different in character from that wherein diamonds have been found hitherto in other parts of the world. The locality alluded to is stated by the author to yield several other kinds of precious stones.

Constitution of Luminous Spectra.—M. Lecoq de Boisbaudran.

Freezing of Water, and on Saturated and Non-Saturated Gaseous Solutions.—M. Barthélemy.—This paper contains the description of some experiments made with the view to explain some irregularities observed by the author when ice was formed at −10° or −12° under peculiar conditions. The author states that, as result of his experiments, the so-called, or, rather, averred explosive force of ice is untenable and does not agree with its plasticity, and that the gases contained in the water, becoming liberated and compressed by the formation of ice, are the cause of the explosive action of that material.

General Theory of Chemistry; Preparation of Oxy-Ammonia. M. Maumené.—The author's chief aim is to explain, by a peculiar theory of his own invention, certain reactions which take place when nitrate of ammonia, or other alkaline nitrates, are acted upon by nascent hydrogen. 200 grms. of nitrate of ammonia are mixed with 2170 grms. of hydrochloric acid (sp. gr., 1·12) and 552 grms. of tin, and care taken to keep this mixture in a very cool flask or retort. After the action is finished, the fluid is treated with sulphuretted hydrogen, next, some alcohol is added, and also some chloride of platinum. After proper purification, a substance is obtained which is soluble in absolute alcohol, and containing 52·6 per cent of hydrochloric acid; mixed with oxide of copper, this substance yields deutoxide of nitrogen. When pure chloride of ammonium is acted upon by a solution of nitrate of silver, care being taken to leave a slight excess of the former salt—in this sense, that there be not enough nitrate to decompose the chloride entirely, there is formed (after filtration, of course) a liquid which, concentrated by evaporation to a syrupy consistence, deposits a peculiar salt, which, at a comparatively low temperature, gives off deutoxide of nitrogen.

Variable State of Electric Currents, and on Extra Currents.—M. Blaserna.

Experiments on the Intrapolar Currents of a Grove Element.—M. Royer.

Nature of Ozone.—M. Dubrunfaut.—We shall return to this paper.

Improvement of Wines by Electricity.—M. Scoutetten.—The author states, in the first place, that a series of experiments, made on the large scale and with various sources of electricity, led to the result that electricity, under whatever form applied (whether as a regular current or a succession of discharges accompanied by sparks), improve wine, rendering it mellow and mature. As to the mode of action of this agent, the author thinks that the bitartrate of potassa present in wine is decomposed: the potassa set free saturates the acids of the wine, and the free tartaric acid, reacting upon the fatty matters present, favours the formation of the ethers which constitute the *bouquet* of the wine. Moreover, a small quantity of water is decomposed, and the oxygen thereof reacts upon some of the constituents of the wine, thereby forming new compounds which are peculiar to old wines.

Cosmos, January 22, 1870.

Artificially-Prepared Alizarine.—The Société Industrielle de Mulhouse has just proposed to grant its medal of honour to him who shall introduce artificially-made alizarine at a sufficiently low price, so that it may be available for general use, instead of and to perfectly answer all the purposes to which madder or its preparations are now applied in calico-printing and dyeing. The competitor is bound to make and deliver a quantity of this product equal to, at

the least, 40,000 kilos. (40 tons' weight) of madder; the product, moreover, must be such that, by the methods of mordanting, &c., now in use, it will yield the same shades of colour and of the same good quality as madder or its preparations. This notice also states—(1) That the artificially-made alizarine prepared by MM. Meister, Lucius, and Co., at Hoechst, near Frankfort, yields, especially for red and puce, results which leave nothing to be desired. (2) M. Pernod, from Avignon,* have just requested MM. Steinbach and Rack, of Mulhouse, to report upon the tinctorial value of a sample of a newly-discovered pigment extracted from the wash-waters of the madder while being converted into garancine; the same gentlemen have also been requested to report upon a sample of oxalic acid obtained from the same source.

Detection of Butyric Acid in Glycerine.—M. Pérutz.—According to the author, concentrated glycerine should simply be mixed, for this purpose, with very strong alcohol and concentrated sulphuric acid, when butyric ether is at once formed and easily recognised by its peculiar pine apple-like smell. Since glycerine often contains large quantities of butyric acid, the author proposes to treat with alcohol the animal charcoal employed for the decolouration of the glycerine; the butyric acid is retained between the pores of the animal charcoal in the state of butyrate of lime soluble in alcohol. The material thus recovered may be applied to the manufacture of butyric ether or butyric acid.

January 29, 1870.

Gold Found in the Rivers of the Scandinavian Peninsula.—M. Meunier.—The quantity of gold dust occurring among the sand of the beds of the northern rivers of Sweden and Norway is larger in quantity than has been hitherto generally known; three men have made, within six weeks, a sum of £80 each, by washing the sand and collecting the gold contained therein of one of the rivers.

Annalen der Chemie und Pharmacie, December, 1869.

This number contains the following original memoirs and papers:—

Ketonic Acids.—M. Wichelhaus.—The intention of the author is to point out the limits, and reduce to regular classification the products of the oxidation of hydrocarbons. There are four different modes by means of which an atom of oxygen can combine with a hydrocarbon (provided the relative position of the carbon atoms remains unaltered). The following are instances of these four types:—

$CH_2.OH$	$CO.H$	CH_2	CH_2
$CO.OH$	$CO.OH$	CO	$CH\}O$
		$CO.OH$	$CO.OH$
Alcohol, or oxy acid.	Aldehyde acid.	Ketonic acid.	Oxy acid.

The paper next contains the following separate sections:—Relation of pyro-uvic acid and aceton—

CH_3	CH_3
CO	CO
CH_3	$CO.OH$
Aceton.	Pyro-uvic acid.

(pyro-uvic acid bears the same relation to aceton as propionic acid to propan); products of the action of bromine upon pyro-uvic acid; substitution products of bibromo-pyro-uvic acid; distillation of pyro-uvates.

Naphthol and Carbonaphtholic Acid.—M. Eller.—When diazo-naphthaline prepared by means of the action of nitrous acid upon naphthylamine, is boiled with water, naphthol, $C_{10}H_7.OH$, is obtained; but this mode of preparing naphthol, although modified in various ways by the author, only yielded traces of the substance alluded to. The author, therefore, considered it better to prepare naphthol by means of the decomposition of naphthaline sulpho-acid salts by fusing caustic potassa. The fused mass is first dissolved in water, decomposed by means of hydrochloric acid, and, after a further purifying process, naphthol is obtained as snow-white brilliantly-crystalline solid substance, fusing at 92°; formula, $C_{10}H_8O$. When naphthol is acted upon by sodium and carbonic acid, it yields a new product, carbonaphtholic acid, $C_{11}H_8O_2$, or—

$$C_{10}H_6\begin{cases}OH\\CO.OH,\end{cases}$$

a solid substance, hardly soluble in water, readily so in benzol, ether, and alcohol, and fusing at about 187°. The salts of this acid are all rather difficultly soluble in water.

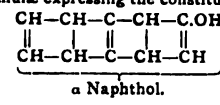
Isomeric Naphthols and some Derivatives thereof.—M Schæffer.—In the introduction to this paper, the author refers, at some length to the researches on this subject, first and foremost of Faraday, and next of MM. Liebig, Regnault, Berzelius, Wöhler, and many others. There exist—α naphthol, $C_{10}H_7.OH$, obtained from naphthalin-sulphate of lead; this α product is characterised by its behaviour with hydrochloric acid; for, if a splinter of fir-wood is dipped, first into an aqueous solution of α naphthol, and then in hydrochloric acid, and then exposed to sunlight, the wood is first coloured green, and at last a brownish red colour. β naphthol also exhibits this reaction, but it is more rapidly performed; and when the wood is dipped afterwards in a weak solution of bleaching powder, a yellow tinge is produced. The author describes, at length, naphthol-ethyl ether, $C_{10}H_7.OC_2H_5$; naphthol-ether, $C_{12}H_{13}O$; α and β naphthol-acetyl-ether, $C_{10}H_7.OC_2H_3O$; phosphate of naphthol-ether, $PO.(C_{10}H_7O)_3$; carbonaphtholic acids; α and β naphthol-sulpho acids—

$$C_{10}H_6\begin{cases}OH\\SO_3H,\end{cases}$$

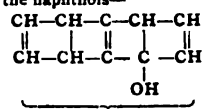
and several of its salts.

Derivatives from Naphthaline.—MM. Darmstädter and Wichelhaus.—A lengthy memoir divided into the following sections:—Binitro-naphthol and bichloro-naphtho-chinon from α naphthol; dinitro-naphthaline; bromo-sulpho acids of naphthaline; naphthobioxyl; bicyanide of naphthaline; bicarbo-naphthalinic acid.

Contribution to the Knowledge of the Constitution of the Derivatives from Naphthaline.—M. Wichelhaus.—We reproduce the formulæ in this paper, since they are, according to the author, the formulæ expressing the constitution of the naphthols—



α Naphthol.



β Naphthol.

Crystallised Algaroth Powder, and on Oxychloride of Antimony.—M. Schaeffer.—When absolute alcohol and chloride of antimony are placed together in a sealed tube and heated to about 150°, in the proportion of 1 molecule of chloride of antimony and 3 molecules of alcohol, there is found, on opening the tube, that, while chloride of ethyl escapes, the sides of the tube are lined with a crystalline mass, which, after having been thoroughly washed with alcohol, proved to consist of chlorine and antimony, without any organic substance, the formula being $Sb_4Cl_2O_5$, the same which has been adopted for the *Pulvis algarothi* of the pharmaceutists. Another experiment, made with equal molecules of alcohol and chloride of antimony, led to the formula SbOCl; and the reaction is represented by—

$$SbCl_3 + C_2H_6O = Sb\begin{cases}OC_2H_5\\Cl_2\end{cases} + HCl;\ Sb\begin{cases}OC_2H_5\\Cl_2\end{cases} =$$
$$= SbOCl + C_2H_5Cl.$$

Constitution of Epichlorhydrine.—M. Darmstädter.—By first causing chloride of phosphorus to act upon epichlorhydrin, and next adding to the product so obtained a quantity of bromine, a fluid was obtained which, by means of fractional distillation, yielded a liquid boiling at about 200°; sp. gr., at 15°, 2·004; formula, C_3H_5BrCl. This substance is identical with chlorhydrodibromhydrine; and the author states that the following formula—

$$\left.\begin{matrix}CH_2Cl\\CH\\CH_2\end{matrix}\right\}O + PCl_3Br_2 = \left\{\begin{matrix}CH_2Cl\\CHBr\\CH_2Br\end{matrix}\right\} + PCl_3O$$

represents the reaction, and thus proves the correctness of the view that epichlorhydrine does not contain hydroxyl.

Preparation of Zinc Ethyl.—M. Wichelhaus.—The gist of this paper is that it is best to apply, for the purpose of the preparation of zinc ethyl, coarsely-divided, that is to say, roughly-filed, zinc, which exhibits a great many points of contact.

Aceto-Chlorhydrine from Octyl-Glycol.—M. Clermont.—The author describes, at some length, the preparation and rectification of aceto-chlorhydrine by means of anhydrous acetic acid, anhydrous hypochlorous acid, and pure octylen. The aceto-chlorhydrine thus obtained is a very mobile, colourless liquid, exhibiting a pleasant aromatic odour and burning taste, insoluble in water, but soluble in alcohol, ether, and acetic acid; it is capable of burning, with a smoky greenish coloured flame; boils at 225°, without decomposition; sp. gr. at 0°, 1·026; formula, $C_{10}H_{19}ClO_2$; vapour density, 7·12. On being treated with caustic potassa in a sealed tube at 180°, a liquid was obtained boiling at 145°; formula, $C_8H_{16}O$—that is to say, octylen oxide.

Uvic, Formic, Glycolic, and Glyoxylic Acids, Products of the Oxidation of Glycerine by Nitric Acid.—M. Heintz.—A lengthy memoir wherein the author minutely describes the method applied by him for proving the four substances named to be produced when glycerine is acted upon by nitric acid.

Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsäuren Corps Sulfazotés of Frémy).—MM. Claus and Koch.—This paper, having also appeared in another German periodical, has already been abstracted (see Chemical News, vol. xx., p. 323.)

Observations and Critical Remarks upon M. Linnemann's Paper "On the Conversion of Butyric Acid into Normal Primary Butyl Alcohol."—M. Lieben.—This short paper is a rather sharp reply to some remarks made by M. Linnemann upon the author's researches on this subject.

Moniteur Scientifique, No. 314, January 15, 1870.

This number contains the following original papers relating to chemistry:—

Bromide of Sodium.—M. Casthelaz.—This paper treats, at length, on the different modes of the preparation of this salt—viz., by direct action of bromine and caustic soda solution; by the decomposition of bromide of iron by means of either caustic soda or its carbonate; by double decomposition of the bromide of ammonium by caustic soda or carbonate of soda. This latter method is used on the large scale

* There is no firm in existence so largely interested in the trade and everything relating to madder, garancine, &c., as this very extensive commercial and manufacturing firm.

by the author, who describes in this paper the arrangements made by him to obtain a product free from chlorine, as well as from iodine.

Researches on the Yama-Mai Silk.—Dr. Bolley.—The silk alluded to is the product of a worm native of China, and feeding on oak leaves instead of on those of the mulberry tree. It appears, from this paper, that several parcels of that silk have been sent to Europe; but at Lyons, as well as at Zurich, great difficulties have been encountered in working up this silk along with, or in the same manner as the ordinary silkworm product. Several gentlemen have investigated the microscopical structure of the Yama-mai silk, and found it in almost every respect to differ from the silk hitherto generally used. The chemical composition, also, of this newly-imported substance differs: it has been found to contain, in raw state, 8·639 per cent of ash, while good raw Italian silk only contains 1·07 per cent; but, when the Yama-mai silk is first treated with some alcohol, next with dilute sulphuric acid, and then cleansed in a soap-bath, the quantity of ash is decreased to 0·59 per cent, while raw Italian silk treated in the same manner, leaves 0·95 per cent of ash. The fibroine and gummy matter of both kinds of silk have been proved identical; the colouring matter of the Yama-mai variety appears to differ from that of ordinary silk. Under perfectly identical conditions, the last-named variety of silk is more hygroscopical than the ordinary kind. Direct experiments instituted by the author have proved that the newly-imported material has a less affinity for mordants than ordinary silk, and both kinds submitted to dye-baths of the same composition and simultaneously have been proved to differ greatly as regards the colour assumed.

On Phenyl Brown, so-called Phénicienne.—MM. Bolley and Hummel.—This substance, also called *rothéine*, is not to be confounded with the brown colouring matter made by Messrs. Roberts, Dale, and Co., at Manchester. The phenyl brown of M. Roth's invention is a substance which, without the use of any mordant, yields, upon silk and woollen fabrics, fast colours. Since it has been alleged that the brown dye alluded to is possessed of explosive properties, the authors have investigated the manufacture and the reactions which take place during the process. The authors find that, when a mixture of nitric and sulphuric acids (1 part of the former of a sp. gr. of 1·35, and 2 of the latter, concentrated) are made to act upon phenol, two different products are always produced—one of these, a solid substance, sometimes like thick tar, sometimes grainy; and a deep red-coloured liquid. When this latter is poured into cold water, a pulverulent brown-coloured substance is precipitated, which possesses all the characteristic properties of commercial phénicienne. The result of the researches arrived at by the authors is that phénicienne is a compound mixture of binitro-phenol and a peculiar amorphous substance which has some likeness to the ulmic and humic substances, but the precise nature of which has not been ascertained.

Action of Shellac upon some Aniline Colours.—M. Labouret.—When a salt of rosaniline is added to a solution of any resin, that solution is red-coloured, if the salt of aniline is soluble in the solvent used to dissolve the resin; the colour has, however, a tendency to turn violet as soon as the solution is heated or evaporated to dryness. An alcoholic solution of shellac, to which fuchsine has been added, turns, on evaporation, to a most magnificent blue colour. This material is insoluble in ether, but soluble in alcohol and acetic acid, the solutions exhibiting a blue colour. The product is, however, very unstable; and the only use this reaction could be turned to is, according to the author, the detection of shellac among other resins, since a very minute quantity of the last-named resin may by this means be detected.

Les Mondes, January 20, 1870.

Nickelising.—It appears that, as the result of researches instituted by MM. Adams, Gaiffe, and Boston, a company has been formed in America (U.S.) with the view of nickelising—*i.e.*, covering other metals, by galvano-plastic means, with a more or less thick coating of pure nickel. Since that metal is very hard, it resists, even in thin layers, rather rough usage; it is not oxidised, even in contact with water, at the ordinary temperature, and the metal assumes a brilliant polish if required. The method employed for the deposition of nickel will be fully described, since this subject was treated of at length at the meeting of the Academy of the 17th instant. The secret of the success is the use of a preparation of a very pure double sulphate of ammonia and nickel. The Company alluded to have established a branch manufactory at Paris under the management of M. Gaiffe.

Species of the Genus Equus.—M. Sanson.

January 27, 1870.

Cast-Iron Stoves.—Dr. Sacc.—The author mentions that some experiments made in his laboratory fully prove that cast-iron stoves, even if they are allowed to become red-hot, are not injurious to health, provided care be taken to ensure a proper ventilation and draught in the chimney, or, rather, in the pipe leading from the stove into it. The use of cast-iron stoves, the author says, is not injurious to health, but becomes so only with imperfect draught; and that defect impairs the good use of all kinds of stoves, no matter whether they be made of cast- or wrought-iron, or of any other material.

Use of Hypophosphoric Acid in Agriculture for the Purpose of Destroying Noxious Insects.—M. Martin.—The author proposes, more especially for the purpose of destroying the *Phylloxera vastatrix*, which makes great havoc in the vineyards, to apply hypophosphoric acid dissolved in water. The makers of phosphorus obtain a quantity of this acid in aqueous solution, which is thrown away as waste; but, since the transport of this waste liquid is too costly (it may be very usefully applied where it can be had with ease), the author describes a method of making hypophosphoric acid by the slow combustion of phosphorus. According to his experiments, 2 grms. of this acid, dissolved in 10 or 12 litres of water, is a strong poison for all kinds of insects, and not only does not hurt plants, but has the effect of increasing the soluble phosphates in the soil.

Researches on the Improvements to be made in Galvanic Batteries.—M. Delaurier.—A lengthy paper accompanied by several engravings.

Thermo-Electrical Apparatus with Galena and Iron.—MM. Mure, Clamond, and Gaiffe.—According to the results of the experiments described at length, this apparatus deserves the attention of all who require galvanic batteries, since regularity and steadiness of action are here combined with economy and the absence of inconvenient vapours.

Zeitschrift für Chemie von Beilstein, No. 2, 1870.

This number contains the following original papers:—

Sulphotoluide.—MM. Otto and Gruber.—Sulphotoluide, as obtained when its solution in benzol is slowly evaporated, is a beautiful crystalline substance, fusing at about 156°, insoluble in water, difficultly soluble in cold alcohol and ether, and readily soluble in benzol, chloroform, and sulphide of carbon; it is soluble, without decomposition, in fuming nitrous-nitric acid, and is not acted upon when heated to 160° in sealed tubes along with a concentrated solution of caustic potassa in alcohol. Formula—

$$C_6H_4\begin{cases}CH_3\\SO_2\\CH_3\end{cases}$$

Two Isomeric Pentachlorobenzols and Bichlorobenzol-Chloride.—M. Otto.—There exist, says the author, two isomeric pentachlorobenzols, C_6HCl_5. One of these is a needle-shaped, crystalline substance, not soluble in ether or alcohol, even when boiling, but soluble in benzol and chloroform, and melts at about 199°; the other substance of this name is readily soluble, even in cold alcohol, and its melting-point is 85°. Dichlorobenzol-chloride, $C_6H_4Cl_2.Cl_6$, is soluble in chloroform.

A New Mode of Formation of Binitronaphthol.—Dr. Balló.—When naphthylamine is treated with nitric acid (sp. gr., 1·35), an energetic action takes place, and the result is the formation of binitronaphthol, according to the following formula:—

$$C_{10}H_7.NH_2+3NO_2.OH=C_{10}H_2^{'''}\left\{\begin{matrix}(NO_2)\\OH\end{matrix}\right\}+NO_2.ONH_4+H_2O.$$

Bulletin de la Société Chimique de Paris, December, 1869.

This number contains the following original papers and communications:—

Studies on the Sewage-Water of Paris.—M. Chevalet.—From this paper, we learn that the portion of the sewage soluble in water (the solid muddy deposit is converted into a kind of dry manure) contains by far the larger quantity of valuable ammoniacal salts, and retains in suspension nitrogenised organic matter, which it is never possible to obtain precipitated; there remains, moreover, similar organic matter in solution. The quantity of soluble ammoniacal salts amounts to 3·371 kilos. to the cubic metre of sewage, and, in addition thereto, it contains 640 grms. of azotised organic matter.

Determination of the Molecular Groups Decomposed by an Electric Current.—M. Bourgoin.—This paper, and the following—

Electrolysis of the Organic Alkalies—M. Bourgoin—are too lengthy to admit of any useful abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, Nos. 1 to 7, inclusive (from December 4, 1869, to January 8, 1870.

This collection does not contain, among the very valuable and interesting scientific matters embraced by it, any original paper on chemistry or sciences connected therewith. The last number, however, contains a very extensive review of a book, "Cours de Chimie Inorganique d'Après la Théorie Typique de Gerhardt, par A. Daxhelet, 2 vols. in 8vo. (Paris: Baudry).

Population of Cuba.—From this paper, we learn that the increase of the population of that island has increased to an amount second to that of the increase of the population of the United States, and, excepting the latter, more than that of any other part of the world. The present population of Cuba exceeds 2,000,000 inhabitants.

The *Revue* above named contains a great many papers of interest to medical men.

No. 8, 1870.

This number does not contain any original paper relating to chemistry or allied sciences, but we meet here with an excellent physiological paper on the—

Effects of the Climbing of High Mountains upon the Human System.—M. Lortet.

No. 9, 1870.

The Astronomical Observatory at Paris.—The staff of this institution has resigned, and the Minister of Public Instruction will

have to choose either to keep M. Le Verrier, and accept the resignation of the whole staff, or accept the resignation of the former, and appoint another director. It appears that very serious dissension has arisen among the parties, giving rise to daily scenes not seemly in a scientific establishment.

Annalen der Physik und Chemie, von Poggendorff, No. 12, 1869.

This number contains the following original papers:—

Thermo-Chemical Researches.—M. Thomsen.—The third instalment of a lengthy paper on this subject, containing the following sections:—Sulphuric acid; selenic acid; sulphurous acid; selenious acid; hyposulphuric acid.

Mineralogical Researches.—M. vom Rath.—The author describes, among other substances, a newly-discovered mineral from the neighbourhood of Laach (Rhenish Prussia). This mineral has been named *amblystegite*. It contains, in 100 parts:—Silica, 49·8; protoxide of iron, 25·6; magnesia, 17·7; lime, 0·15; alumina, 5·05; water, 0·5. *Meteorite from Girgenti, Island of Sicily.*—It appears that of this meteorite only very small bits have been obtained in some museums. The author accidentally got a large lump which a friend sent him from Palermo, and thus an analysis became possible, giving, in 100 parts, the following results:—Chrome iron, 1·20; sulphur, 2·24; iron, 3·43; silica, 43·41; alumina, 1·57; magnesia, 26·84: lime, 1·85; protoxide of iron, 17·96; protoxide of manganese, a trace; soda, 1·50.

Crystallographical Description of the Salts derived from Sulpho-Acids of Phenol.—M. vom Rath.—Purely a crystallographical monograph.

Experiments on Dispersion Figures (Zerstrenungsbilder).—M. Bezold.

Vibrations of a Layer of Air corresponding to those of a Fixed Disc.—M. Vierth.

Reply to the Critics of M. Boltzmann.—M. Most.

Experimental Researches on the Effect Heat Exercises upon Electromotive Force.—Dr. L. Bleekrode.—A lengthy monograph of great merit on a subject first investigated by Faraday.

New Sulphur Salts (Third Paper).—M. Schneider.—The author describes:—Potassiumplatinum-sulphoplatinate, obtained by fusing together 2 parts of spongy platinum, 6 of pure carbonate of potassa, and 6 of sulphur. After cooling, the mass is treated with water; what remains undissolved, exhibiting a crystalline appearance and reddish lead colour, accompanied by metallic lustre, is the salt alluded to—

$$K_2S,\overset{II}{Pt}S,\overset{II}{Pt}S,\overset{IV}{Pt}S, \dashv PtS_2.$$

Sodiumplatinum-sulphoplatinate—

$$Na_2S,\overset{II}{Pt}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \dashv PtS_2.$$

Potassiumplatinum-sulphostannate—

$$K_2S,\overset{II}{Pt}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \dashv SnS_2.$$

Sodiumplatin-sulphostannate. Disodiumplatinum-sulphoplatinate—

$$Na_2S,Na_2S,\overset{II}{Pt}S,\overset{IV}{Pt}S \dashv PtS_2.$$

Argentumplatinum-sulphoplatinate—

$$Ag_2S,Ag_2S,\overset{II}{Pt}S,\overset{IV}{Pt}S \dashv Pt_2.$$

Thalliumplatinum-sulphoplatinate; this salt, obtained by a rather complex process, is insoluble in cold water; dilute hydrochloric acid extracts all the thallium, without the least evolution of sulphuretted hydrogen; formula—

$$Tl_2S,Tl_2S,\overset{II}{Pt}S,\overset{IV}{Pt}S \dashv PtS_2.$$

Researches on Mica Combinations.—M. Rensch.—A purely mineralogical paper.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 7th.—Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.
—— London Institution, 4.
TUESDAY, 8th.—Royal Institution, 3. Professor Humphry, "On the Architecture of the Human Body."
—— Institution of Civil Engineers, 8
—— Photographic, 8. Anniversary.
—— Ethnological, 8.
WEDNESDAY, 9th.—Society of Arts, 8.
—— Geological, 8
—— Microscopical, 8. Anniversary.
THURSDAY, 10th.—Royal Institution, 3. Prof. Odling, "On Chemistry."
—— London Institution, 7.30.
—— Royal, 8.30
—— Zoological, 8.30
—— Royal Society Club, 6.
FRIDAY, 11th.—Royal Institution, 8. Dr. Carpenter, "On Temperature and Life in Deep-Sea."
—— Astronomical, 3. Anniversary.
—— Quekett Club, 8.
SATURDAY, 12th.—Royal Institution, 3. Mr. Scott, "On Meteorology."

NOTES AND QUERIES.

Egg and Blood Albumen.—Can any of your readers inform me of a good method of testing the value of egg and blood albumen.—W. B.

Production of Ozone.—Would you kindly inform me, through the medium of your valuable journal, the cheapest and best mode of producing ozone in quantity, and if a process described in the *Daily Telegraph* some months since is practicable, and if protected by a patent?—X. Y. *Z.*

TO CORRESPONDENTS.

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BOOKS RECEIVED.

The Manchester Examiner and Times, Jan. 29, 1870, containing a letter by Dr. Bedford on "The Flames upon the Sun."
On the Combining Power of Chemical Elements, by Prof. S. D. Tillman. New York.
The Medical and Surgical Reporter.

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On Food; its Varieties, Chemical Composition, Nutritive Value, Comparative Digestibility, Physiological Functions and Uses, Preparation, Culinary Treatment, Preservation, Adulteration, &c. By H. LETHEBY, M.B., M.A., Professor of Chemistry in the College of the London Hospital, and Medical Officer of Health and Food Analyst for the City of London.

London: Longmans, Green, and Co., Paternoster Row.

Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

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THE CHEMICAL NEWS.

VOL. XXI. No. 533.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By WILLIAM ARNOT, F.C.S.

(Continued from p. 50.)

IX. CHAR TREATMENT.

WHEN a refiner discovers his char stock to be in a "diseased" condition, he naturally begins to look about for some method of treatment, by the adoption of which the quality of his char may be improved. The search is usually made in a hap-hazard way; no very definite notion of what the disease really is which affects his char having been obtained, a process for the removal of iron or lime may be adopted when the real source of the inefficiency of the char may be excess or deficiency of carbon, or such like. The first step which ought to be taken when a char ceases to give satisfactory results is to have it carefully analysed; but this will be of comparatively little use if analyses have not been formerly made. A regular monthly or bi-monthly analysis of every refining stock should be made, and the results of each compared with those preceding; the refiner will thus be able to trace the nature and progress of disease in his char, if any exists. If suspicion is thus aroused that all is not right, more frequent analyses should be made, and, at the same time, some well-considered system of treatment adopted. It may be well to draw attention here to the obvious necessity for such analyses being made with rigorous care. An increase or decrease of carbon from week to week or from month to month of 0·5 per cent, increase or reduction of calcic carbonate to the same extent, or an increase of iron to the extent of 0·1 per cent of oxide, are most important indications, and ought to receive the special attention of both analyst and refiner.

A fair idea of the nature of the defect having been obtained, the mode of treatment most likely to improve the char must be carefully considered. It will very frequently be found that the safest, most efficient, and, in the end, least expensive course to follow will be to increase the washing; to use the washing water boiling, instead of simply "warm"; to see to the kilns and coolers being tight, and the working of them specially attended to; to reject suspicious sugars; and generally to give greater attention to the employment of careful and efficient workmen. The writer has more faith in measures such as these, than in the hasty adoption of special systems of treatment, which often lead to michievous results. But, in the face of every precaution, "diseases" do creep in sometimes, and the adoption of some special measures may be imperative; but, whatever the system to be adopted, numerous and frequent, carefully-conducted, small-scale experiments should first be made. The diseases open to special treatment are, as indicated in the preceding note, principally excess of lime and iron. For the removal of these, the following processes have been adopted with more or less success.

1. *Fermentation* of various kinds and degrees. The char may be left in the cisterns with a little "sweet" remaining in it (*i.e.*, without being thoroughly washed) for some days, during which time a brisk action will take place: the traces of sugar, as well as the several organic impurities left in the char, are decomposed, with formations of various weak acids, which combine with the lime, forming salts easily removable by washing. Or a quantity of "sour water" may be run upon the char, and allowed to stand as before; the action will be the same, slightly intensified. Many modifications of this system are in use, the action in all cases being the same in kind, differing only in degree. Crude acetic acid and churned milk have also been used to promote and intensify acetic and lactic fermentations.

Fermentation is a simple and cheap mode of treatment, but the results, although generally in the right direction, are not usually very great. The amount of acid produced is comparatively trifling, and has seldom any action upon the iron, enough lime being generally present to saturate the acid as produced. It has its harmlessness to recommend it; but it keeps the char an objectionably long time out of use, and, moreover, monopolises the char cisterns to a serious extent. This latter objection may be got over by adopting a system of "dry fermentation," in which the char, well drained, but moist, and containing the fermenting agents already referred to, is removed from the cisterns, and allowed to lie in a heap for a week or two, or until all action has ceased. This process, however, involves a large amount of additional labour, and, as in the other case, keeps the char out of use longer than desirable.

2. *Dilute Hydric Chloride* has been used, in various ways and in all degrees of strength; and, for the removal of iron, perhaps no better agent can be employed. Sodic sulphite has been recommended to be used, along with hydric chloride, for the removal of iron; but the writer has not found the results of such treatment at all satisfactory. Hydric chloride must at all times be used with extreme caution; very dilute solutions should always be preferred, though the amount of lime or iron removed should be the smaller. The effects of any acid treatment is never perfectly satisfactory: the amount of impurity removed is generally less than anticipated; danger of injuring the structure of the char always exists; in whatever way the acid is applied, some of the char is certain to get more than its share, another portion getting less; while the entire removal of the acid from the char, after it has done its work, is difficult, if not impossible. Char, after having been treated with acid, washed, and re-burned, always shows an acid reaction—so difficult is the acid to wash out; and this residual acid has the effect of misleading the refiner when his sugar-liquor passes through the char for the first time. The liquor will look unusually bright, and light in colour; but colour due to the presence of traces of acid is valueless, as, in the process of boiling, it entirely disappears. Dr. Wallace, in his lecture to the Chemical Society, indicates that the colour of the sugar produced in such circumstances is superior, though the syrups are increased in quantity. This the author has not found to be the case; the syrups are increased, but the colour of the sugar is not improved.

3. *Gaseous Hydric Chloride.*—Mr. Beanes's process has already been referred to (Note VIII.) When the circumstances which obtain are such as to warrant its use, great care must be taken to have apparatus of the best construction, and thoroughly trained workmen to attend to the various operations involved. When the excess of lime has been removed, the process will, of course, be stopped until, by a sufficient increase of that impurity, it can again be used with safety and with profit. Dry gaseous hydric chloride has no action upon the iron; so that, for the removal of that powerfully-injurious agent, it is inapplicable.

Various other acids have been used with a view to improve the quality of animal charcoal, but (unless in very special cases) with very discouraging results. Even carbonic acid has been used, forced into the char in the gaseous form under high pressure, under the impression that the calcic carbonate would be changed into bicarbonate, and thus rendered soluble. This may serve as an

illustration of a rather numerous class of "inventions," the results of which are not only valueless, but, in some cases, most injurious. A case has come under the writer's notice, almost too absurd to be mentioned, in which undilute oil of vitriol was poured direct from the carboys upon the char in the cisterns. After the mixture had been allowed to act *a sufficient length of time*, it was dug out in blocks with picks! This process was conducted under chemical supervision!

The preservation of char in a state of efficiency is perhaps the most important problem in the sugar-refining industry; and certainly it were much better for the refiner to devote his best energies to the retention of his char in good condition, than to be compelled to adopt expensive, troublesome, and often questionable processes, with a view to restore qualities which, through careless working, have been lost. The question of char treatment is a most troublesome one; and, although almost every likely process has been practically tried, both on the large and small scale, by the author, the results have never given him unalloyed satisfaction. He is, therefore, the more desirous of impressing upon refiners the desirability of caring well for good char when they have got it.

A favourite "cure" for faulty char with some, is to mix in new or faultless char in various proportions; but, as must be self-evident to anyone who will carefully look at the subject, this is only to disguise the weakness of the old by the potency of the new. A char having a higher average quality will doubtless be the result of such admixture; but it is a mistake to suppose that the faulty char will thus be cured.

St. Anne's Laboratory, Lasswade, N.B.,
January, 1870.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 52).

A very ingenious printing process, known as *graphotype*, has been lately brought forward. In this, a quantity of finely-powdered chalk is compressed into a solid tablet; this is drawn upon with a fine brush charged with an ink which hardens the chalk wherever it touches. The drawing is then sent to the patentees, who brush away the chalk, leaving the lines standing. A mould is made in plaster of Paris, from which a cast in type-metal, capable of yielding impressions in the common printing-press, is taken. Every facility is afforded by the Graphotyping Company, No. 7, Garrick Street, W.C., to persons wishing to test the merits of the process.

Lithography printing remarkably from all the processes of multiplying impressions just described. While, in plate and surface printing, it was essential that there should be a difference of level between the parts intended to print light and dark, in the various lithographic processes, light and dark are all printed from the same surface. The operation is purely a chemical one, and depends upon the mutual repulsion of oil and water. The stone used is a fine-grained and very compact limestone, capable of bearing a high polish, principally supplied from quarries at Solenhofen; and it would seem that it was destined to transmit natural history information to posterity, as many of the slabs enclose fossil-insects, as perfectly preserved as if they had been shut up between the leaves of a book for a few weeks, instead of ages. The British Museum has a very large collection of these specimens of Nature's lithographs. If a grease-mark be made upon the smooth surface of this or similar stone, and it then be wetted, it will be found, upon passing a roller charged with printing-ink over the stone, that the ink will adhere to the greasy portions, while it will be repelled by the parts that are wet. If the stone, with a sheet of paper on it, be passed under the press, an impression will be obtained; and, by a series of wettings and inkings, the operation may be repeated any number of times. This is the foundation of all the lithographic processes, which are numerous, and suited to the production of a great variety of effects, mostly by the use of means differing less from the ordinary manipulations of the artist than any of the other means of multiplying drawings. The use of grease or oil as a material for drawing upon stone is open to many practical objections; therefore, a greasy material is manufactured, more closely resembling, in form, that used in the ordinary process of drawing. It is composed of a mixture of tallow, soap, wax, and shellac, with a portion of lamp-black, to give it sufficient colour to guide the artist in making his drawing. The proportions vary according to the purpose for which it is required, and the combination of the materials is a matter of very nice manipulation. It can be procured, properly prepared, of the dealers in lithographic materials, and will be found in the form of crayons of three degrees of hardness, which are used like ordinary artists' chalks, and cakes, which are soluble in water, and can be rubbed down like Indian-ink, care being taken to use distilled or very pure water, otherwise, from the soapy nature of the ink, it will not mix freely.

In making drawings with the ink, a fine brush or suitable steel pen may be used; and, if the drawing is to consist entirely of ink-work, a polished stone should be employed. Care should be taken not to touch the stone with the fingers, as every greasy mark, although invisible when made, will print when the stone is rolled in. If the crayons, or chalk, are used, the stone should be what is called "grained," that is, its surface should be prepared with a texture somewhat like that of drawing-paper, to enable the chalk to be rubbed off the crayon and held by the stone. The fineness or coarseness of the grain must be suited to the nature of the drawing: microscopical drawings usually require a very fine grain. The manipulation is somewhat like that of pencil and chalk drawing on paper, only taking certain precautions rendered necessary by the nature of the material. All light tints should appear darker on the stone than they are intended to print, as they lose some of their strength in the preparation which the stone undergoes before it is printed from. Dark tints should be worked up gradually, by repeating the touch of the chalk in as many directions as possible, so that the minute papillæ, or roughnesses, which form the grain of the stone may be loaded with the chalk on all sides, and consequently suffer less in the etching process. Any attempt to produce a dark tint or spot by a vigorous and sudden touch, as in pencil drawing, will generally fail when the stone is printed. Ink outline may often be used with great advantage in combination with chalk shading. In this case, the outline should be put on the stone with the ink first, and the shading done afterwards, as it is difficult to see the ink outline

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

when the stone is covered with shading, and the chalk is also likely to hinder the adhesion of the ink to the stone. Care should be taken that the work is perfect before it is sent to the printer, as but little or no alteration can be made after the proof is taken. This is one of the greatest defects of lithography, and is unlike copper-plate, where the artist goes on improving and re-touching, after a series of proofs, until perfection is attained. When the printer receives the stone, he washes it with very dilute nitric acid, which converts the soapy ink into grease, and prevents its being washed off in subsequent processes. The stone is then covered with gum-water, which adheres to the parts not touched with ink, and prepares the stone to receive the wet. Then, by a series of spongings with water and rollings with printing-ink, the stone is made ready to yield a very large number of impressions. With a little perseverance and the assistance so kindly afforded by most lithographic printers,* any person who can draw may hope, after a time, to re-produce his works upon stone with tolerable success.

Another process, capable of producing very delicate results, and well suited for microscopical purposes, is that known as engraving on stone. It is by this mode that most of the beautiful works of Mr. Tuffen West are executed. It consists in scratching the lines and dots forming the picture with a diamond-point on a highly polished stone, of which the surface has been slightly coloured, to render the marks visible. Care should be taken not to cut deeply, but only slightly to scratch the stone. The printer rubs the engraved stone with grease, which adheres to the scratches, which, when the stone is rolled in, print as black lines. This process requires much more practice than either chalk or ink drawing; but its results, when well executed, almost rival fine steel-engraving.

White-line lithography, on a black ground, is useful for representing many tissues. It is executed on a polished stone, which is prepared by the surface being covered either with a coat of lithographic ink or grease and lamp-black. The artist, with a diamond-point, cuts through the black ground, taking care to lay bare and slightly incise the stone. The diamond is a very free-working tool, and obeys the hand beautifully after a little practice. This process is remarkably easy and expeditious, and is worthy of having its powers developed. Very little use has been made of it at present. It seems capable of great delicacy; and, as so many microscopical observations are made on a black ground, either with the parabola or by reflected light, this process seems to be one very well suited to the wants of the microscopist. As a compensation for the ease of execution, it would seem that black-ground lithographs entail some trouble on the printer, as the fine lines are apt to fill up; but as this kind of printing becomes more frequent in use, doubtless the difficulty will be thought much less of. The author strongly recommends microscopists who have drawings to publish, and who cannot afford the cost of professional assistance, to master some one or other of the lithographic processes. Their work will doubtless, even after some practice, be rough, and not equal to the productions of experienced lithographic artists; but it will have an advantage which is possessed by no copy of a drawing, however good: it will be an autograph, re-producing all the author's peculiarities of style, and preserving those points which are very often lost in the copying of drawings by those who are not familiar with the subjects represented.

The student who wishes to render the microscope really valuable to him must determine, after mastering the technical difficulties of his instrument, to apply himself diligently to the study of some particular subject. One of our greatest authorities (Dr. Carpenter) speaks of "microscope power running to waste" in this country. Another author says:—"We have the best microscopes in the world, and the fewest observations." And it is to be feared that there is much truth in these statements. The microscope is, in the hands of many persons, only a costly toy. It should be regarded rather as a tool, and the naturalist's most efficient one. The work of the microscope does not consist in resolving the striæ of difficult diatoms; this has been done over and over again, and yet we seem to be not much nearer the truth than before. However, if we cannot understand the markings of the diatoms, they have done us service: they have caused our instruments to be continually improved, till now it is doubtful whether much more advance can be made.

The beginner is strongly recommended to go carefully through the tables at the end of Dr. Beale's "How to Work with the Microscope," carrying out the principles there laid down; for, though the work is principally written for students of anatomy and physiology, it may be consulted by all enquirers with great benefit. Great progress may always be made if the student has the good fortune to be acquainted with some working microscopist. Many such are glad of the assistance of others; and, although the beginner may not be able to originate an enquiry, he may confirm and verify the observations of others, and, in so doing, add largely to his own stock of knowledge.

The numerous microscopical societies in London and elsewhere offer great facilities to the young student, by giving him opportunities of becoming acquainted with the best practical microscopists. Many of the societies have regularly organised collecting-excursions, under the direction of experienced persons. By attending these meetings much information may be gained.

The recent application of the spectroscope to microscopical research will no doubt be a very promising field of enquiry. Already, besides other discoveries, the distinction between two vegetable reds (those of the grape and elder-berry) has been pointed out by its means, and will probably lead to the detection of methods of adulteration which have hitherto baffled both chemists and microscopists; and many more very important results may be expected to be elicited by steady application and careful use of this most delicate means of distinguishing colour. The use of the microscope is far from being confined to those sciences which are connected with natural history. The instrument has been applied, with the greatest advantage, to researches on inorganic matter; and much valuable information has been obtained by the observations of Mr. Sorby and others who have devoted themselves to such enquiries.

* The author has been much indebted to the artists in the office of Mr. West, Hatton Garden, for much valuable information.

ON ORGANIC MATTER IN THE AIR.*

By Dr. R. ANGUS SMITH, F.R.S., &c.

I HAVE worked and written so constantly on impurities in air and water that last year I was told by a periodical of high position that I was quite regardless of the impression made on timid persons, and I began to compare myself to a collector of "varieties," who is often obliged to bring up his curiosities every five years. When I read of the new experiment by Professor Tyndall, showing to the naked eye the numberless bodies in the air, I was abundantly gratified, as I obtain them only by a laborious although simple process. When, however, Dr. Tyndall began to show the character of these bodies, it "smote the chord of self," as I imagined that I had long ago proved that not only organic and inorganic, but organised, forms exist in the atmosphere. Neither do I claim this as my original idea, looking rather to the fulness of proof and quantitative results as mine. I think, therefore, I may remind my friends of some of my work, as I find that they forget; and even I forget the exact words used by myself, and must read up.

But, as people do not read much on a subject, I will begin at the end. I have been for two years attempting to measure the amount of putrescible matter in the air of the towns and country-places; and I have succeeded to a considerable extent. I also measure the amount that has putrefied and left its remains in the air—the sewage of the atmosphere. Some of my results are published. I have promised some very soon, and some have been ready for printing, under the head of "Chemical Climatology." The proof of organic matter is old. I seek the quantity in various towns and parts of towns.

I shall not here give a history of the enquiries. So many people claim to have something to say in the matter, that I might amuse myself, if not the public, by a long account. At present, I profess to keep almost entirely to my own work. The knowledge of organic matter in the air has never been absent entirely from men's minds in historic times; but the words of Bishop Berkeley are so clear that I prefer to quote them; besides, he is far enough back for the purpose. He says, in "Siris" (par. 140):—

"Nothing ferments, vegetates, or putrefies without air, which operates with all the virtues of the bodies included in it—that is, of all nature. . . . The air, therefore, is an active mass of numberless different principles—the general sources of corruption and generation; on the one hand, dividing, abrading, and carrying off the particles of bodies, that is, corrupting or dissolving them; on the other, producing new ones into being, destroying and bestowing forms without intermission."

And, in paragraph 141, he says:—

"The seeds of things seem to be latent in the air, ready to pair, and produce their kind whenever they light on a proper matrix. The extremely small seeds of ferns, mosses, mushrooms, and some other plants, are concealed and wafted about in the air, every part whereof seems replete with seeds of one kind or other. The whole atmosphere seems alive. There is everywhere acid to corrode and seed to engender. Iron will rust, and mould will grow in all places."

No man has, before or after him, expressed this truth more completely and beautifully. It is hard to improve it by one word. Still, this age demands more detailed knowledge and exact theory. Besides, the work of every few years requires to be done again, to suit modern methods, although it must be confessed that there is room for the cynic to say that Bishop Berkeley and all the ancients and moderns might be classed with Topsy, who think they have explained all by saying—"It grows."

I began to examine the air in 1846, and I brought a short notice before the Chemical Society: a simple mode of obtaining organic matter in the condensed breath on windows is recorded in their transactions. On account of this commencement, which promised favourably, the British Association requested me to report on the subject. My report, published in 1848, was considered to have made advance, and was marked out for special mention by the President of the succeeding year, so that the words were not hidden. I quote a part, "That animals constantly give out a quantity of solid organic matter from the lungs, may readily be proved by breathing through a tube into a bottle, when the liquid or condensed breath will be collected at the bottom of the bottle; or by breathing through a tube into water, when a solution of the same substance will be found in the water. This would scarcely require proof if we consider that breath so frequently has an organic smell."

"If this condensed breath be put on a piece of platinum, or on a piece of white porcelain and burnt, the charcoal which remains and the smell of organic matter will be conclusive. It it be allowed to stand for a few days (about a week is enough), it will then show itself more decidedly *by becoming the abode of small animals*. These are rather to be styled animalculæ, and very small ones certainly, unless a considerable quantity of liquid be obtained; they may be seen with a good microscope. Animalculæ are now generally believed to come from the atmosphere and to deposit themselves on convenient feeding places; that is, they only appear where there is food or materials for their growth, and they prove of course the existence of that continuation of elements necessary for organic life. At the same time their presence is a proof of decomposing matter, as their production is one of the various ways in which organised structure may be broken up."

"I mentioned some time ago that I had got a quantity of organic matter from the windows of a crowded room, and I have since frequently repeated the experiment. This matter condenses on the glass and walls in cold weather, and may be taken up by means of a pipette. If allowed to stand some time it forms a thick, apparently glutinous mass; but when this is examined by a microscope, it is seen to be a closely matted confervoid growth; or, in other words, the organic matter is converted into confervæ, as it probably would have been converted into any kind of vegetation that happened to take root. Between the stalks of these confervæ are to be seen a number of greenish globules constantly moving about, various species of Volvox, accompanied also by monads many times smaller. When this happens the scene is certainly lively and the sight beautiful, but before this occurs the odour of perspiration may be distinctly perceived, especially if the vessel containing the liquid be placed in boiling water.

"If air be passed through water a certain amount of this material is obtained, but I have found it difficult to pass a sufficient quantity through. If it is made to pass rapidly, *absorption does not take place*, and evaporation of the water is the consequence; if it passes slowly, it requires several weeks to pass a 100 cubic feet through a small quantity of water. I continued the experiment for three months, but although I obtained sulphuric acid, chlorine, and a substance resembling impure albumen, I did not get enough to make a complete examination; and indeed this could not be expected, as I found that in that time less than 1000 gallons of air had passed through.

"When this exhalation from animals is condensed on a cold body, it, in course of time, dries up, and leaves a somewhat gelatinous organic plaster. We often see a substance of this nature on the furniture of dirty houses, and, in this case, there is always a disagreeable smell perceptible."—*Mems. Brit. Association Meeting, held in August*, 1848.

I quote the words used by the President of the Association simply to show that the paper was well known:—

"For instance, the causes which, in our great cities, hasten the death and debase and embitter the life of so

* Read before the Manchester Literary and Philosophical Society, Jan. 25th, 1870.

many have at last been forced by chemists and physiologists on the notice of the public. Look at Dr. Smith's report on the air and water of towns in this volume; and, when we think that the victims of the deadly influences which are there revealed are chiefly found among the people whose industry is the foundation of our greatness,—that every year cut off from the life of each of these is so much subtracted from national wealth,—even were all moral sense and religious feeling dead in us, we must confess that the knowledge which is capable of averting them 'is of use.'"

Looking over these words at this distance of time, it seems to me scarcely possible to write more clearly, although some of the words I should prefer to see changed. Still, the subject was a continued study, and it was my strong desire to measure exactly the amount of organic matter. Not to detail all the attempts, I may come to the report to the Cattle Plague Commission in 1866, in which I give some general views and allude to the works of others. The following may be quoted:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act *as if planted by some seed*, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result would seem to be that, whilst the decomposition of organised beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases; and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a warmer sun and a richer vegetation than is to be found in the north. This, however, is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing mater, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is, and has always been—What is the nature of that substance which may be said to form the seed, or germ, of the disease? Chemists have been inclined to consider it a substance in process of decay, as the quotation from Liebig already given shows. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere (in all places), and that they are the cause of some hitherto entirely mysterious phenomena, putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found to enter, that in cellars and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous enquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, hydrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, smallpox, or black death."

I did not enter on Pasteur's ground,—the action of organisms in producing fermentation.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

February 3rd, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

MR. CHAPMAN read "*A Note on the Organic Matter Contained in the Air.*"

Some time ago, the author, in connection with Mr. Wanklyn and Mr. Smith, found that the smallest traces of nitrogenous organic matter in water could be detected by converting the nitrogen of the organic matter into ammonia, and then trying with Nessler's test. It occurred to the experimenters that the process might be extended to the investigation of the air, by washing it with water, and examining the water; but Mr. Chapman found the operation of washing the air more difficult than he had expected. It seemed the most obvious method to draw air through water, or through some other medium which would have afterwards to be washed with water. The absorption by water alone proved insufficient. Filters of cotton-wool and gun-cotton acted very well; but neither of the two materials could be obtained free from traces of nitrogenous substances. Asbestos seemed to be sufficiently good; but the preparatory treatment it has to undergo before its use in the experiment is too troublesome. Lastly, finely-powdered pumice-stone was tried as a filtering medium, and was found satisfactory in all respects. It has to be heated to redness before it is employed, and is then moistened with some water, spread over coarser pieces of pumice, which rest on some wire-gauze fitted into a funnel. When a sufficient quantity of air (say 100 litres) has been drawn through the apparatus, the pumice is transferred to a retort which contains water freed from ammonia and organic matters; and the operation is now proceeded with exactly as if it were an estimation of nitrogenous organic matter in a sample of water.

By this method, Mr. Chapman found that the air of crowded rooms contains suspended nitrogenous organic matter, as well as volatile organic bases. The first can be removed by filtration through cotton-wool; the latter pass through the filter, and, when conducted into water, can be detected there. Air collected from the neighbourhood of a sewer contained notable quantities of these volatile bases. The author thinks it would be of interest to investigate, by the above-described method, the air in hospitals, fever-wards, and the like places.

With respect to the examination of the volatile bases occurring in the air—

Dr. MILLS suggested that the charcoal out of the Stenhouse air-filter might furnish a good means for collecting those bases.

In another paper, Mr. CHAPMAN communicated "*Some New Reactions of Alcohols.*"

Amylic alcohol, as commonly obtained, consists of two liquids, one rotating a ray of polarised light, the other not. The two may be separated by distilling the mixture from soda, calcic chloride, &c. The non-rotating alcohol is retained; the rotating distils over. But, by repeated distillations, it was found that the rotating alcohol is converted into the non-rotating by the very treatment employed to separate the two. No difference in the physical properties of the two alcohols is perceptible. The compounds of the non-rotating liquid do not turn the ray of polarised light; those of the rotating do, and that in an opposite direction to the original alcohol. These facts seem to indicate that the internal structure of organic compounds is not so permanent as we are in the habit of thinking. Another observation Mr. Chapman made whilst pursuing these experiments was that caustic soda is not merely unable to dry alcohol, but that it actually hydrates it. On proper investigation, it turned out that the sodium replaces the hydrogen of the alcohol, whilst the displaced hydrogen takes the place of the sodium in the caustic soda, and thus produces water.

The PRESIDENT, referring to this latter observation, remarked that it confirmed the idea of a double decomposition taking place when potassic hydrate is dissolved in alcohol—an idea derived from the well-kown reaction of carbonic acid on a solution of potassic hydrate in alcohol, whereby ethylo-potassic carbonate, as well as potassic carbonate is formed.

Mr. PERKIN exhibited a modification of Berthelot's method for the synthesis of hydric cyanide by direct union of acetylene and nitrogen under the influence of the electric spark. Mr. Perkin takes advantage of the fact that nearly all the hydrocarbons yield, when submitted in the state of vapour to the action of the spark, more or less acetylene. Nitrogen was caused to bubble through benzole; then to pass through a globe, in which the spark was discharged; and thence into a solution of silver. After a few seconds, abundant evidence of the formation of hydric cyanide was obtained. Hydric cyanide was also produced when the spark was discharged through a mixture of ammonia gas and ether vapour. If, however, nitrogen, instead of ammonia, is employed, no cyanide is produced, notwithstanding that acetylene is formed from the ether. Mr. Perkin's modification of Berthelot's method is well adapted for purposes of lecture-demonstration.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. P. JOULE, LL.D., F.R.S., President in the Chair.

"*On the so-called Molecular Movements of Microscopic Particles,*" by Professor W. STANLEY JEVONS, M.A.

Robert Brown, the celebrated botanist, first pointed out, in the year 1827, that minute particles of unorganised matter suspended in water exhibit movements which may easily be mistaken, and were formerly mistaken, for the movements of living animalculæ. This motion is exhibited more or less by all substances which are reduced to a sufficiently fine state of division (1-5000th inch in linear magnitude to 1-50000th), and the phenomenon is familiar to all occupied in microscopic observation. Vague suggestions have been often put forth that the motion is due to heat, to electricity, or to chemical affinity, but I have been able to find few published experiments on the subject, and those not of a conclusive kind.

In investigating this phenomenon, I did not learn much by varying the solid suspended substance. The silicates, indeed, appeared to be generally the most active substances, and the purest quartz cystal when reduced to fine powder oscillated rapidly; but such different substances as charcoal, red phosphorus, antimony, and sulphur were also very active. I cannot affirm that any substance is free from movement, but the metallic oxides, and the earthy salts such as carbonate of lime, appeared to me somewhat less active in comparison.

In varying the liquid, however, by dissolving different salts therein, I was soon struck by the fact that the purest distilled water alone gave the movement in the highest perfection. With a few exceptions, soon to be noticed, all acids, alkalies, or salts tended to diminish the movement in a manner wholly independent to their peculiar chemical qualities.

The inquiry was much facilitated by discovering that the microscopic movement is closely connected with the suspension of fine powder in water.* Clay and pounded glass which are most active in the microscope are also capable of remaining long in suspension. All acids, alkalies, or salts which checked the motion under the microscope were found also to have a power which has not been sufficiently noticed, of precipitating suspended matter. At the same time gum arabic, which possesses a most extraordinary power of exciting the molecular movement, is also capable of maintaining powder in suspension, and has long been used for this purpose in the manufacture of ink. The molecular motion does not directly affect the gravity of the particles, but it prevents the particles from aggregating together into larger bodies and thus overcoming the resistance of the liquid.

That the motion is due to electricity I was soon convinced, by the close analogy with the circumstances in which electricity is produced by the hydro-electric machine. Armstrong and Faraday found that pure water in this machine alone produced much electricity, and that almost any salt, acid, or alkali prevented the action by rendering the water a conductor. Ammonia, however, is a remarkable exception, because it does not render water a good conductor, and does not prevent the hydro-electric machine from giving off electricity. In trying ammonia as an *experimentum crucis*, I found that it did not stop the microscopic movement, and had almost an inappreciable effect in precipitating suspended matter. A solution of 10 per cent of ammonia would have less effect than 1-100th per cent of sulphuric acid. The proof is rendered practically certain by the fact that boracic acid, which was also ascertained to be a non-conductor by Faraday, does not precipitate matter from suspension.

It is right to add, however, that in the case of acetic acid there is a discrepancy; Faraday stated that it does not render water a conductor; but I find that, in common with the other vegetable acids which I have tried, it occasions precipitation. The conducting qualities of the substance have not been determined with sufficient accuracy to render a mistake impossible.

It is probable that silicic acid does not render water a conductor, as I find that silicate of soda tends to increase rather than diminish microscopic movement, and is another remarkable exception to the general precipitating power of soluble substances.

I entertain no doubt that microscopic movement is closely connected with the phenomena of osmose so fully investigated by the late Mr. Graham. The connection is that of action and reaction; for if a liquid is capable of impelling a particle in a given direction, the particle, if fixed, is capable of impelling the liquid in an opposite direction by an equal force. The earthenware jars used by Graham in many of his experiments are composed of a substance highly active

* I have since found that the microscopist Dujardin noticed this connection. See "*Manuel Complet de l'Observateur au Microscope.*" Paris, 1843, p. 60.

under the microscope, and the fact that osmose is most shown by very dilute solutions (1 per cent or less) is entirely in accordance with the electric origin of the phenomenon.

I consider it to be established experimentally that the microscopic movement is due to electric action, and if I may venture to suggest a somewhat speculative explanation of the action I would point to the experiments of M. Wiedemann on electric osmose. It was first observed by Mr. Porret that when the poles of a battery are placed in two portions of water separated by a porous division, not only is some of the water decomposed, but another and far larger portion is impelled towards the negative pole. M. Wiedemann, having exactly investigated the phenomenon, found that, for one part of water decomposed, 5,000 parts were transported through the porous septum. This impulsion is greater as the resistance of the liquid is greater, and ceases altogether when sufficient acid or salt is added to render it a good conductor. Every particle which is thrown into a polar condition by the action of water must be capable in a minute degree of exerting a similar force. In ordinary osmose the particles being fixed cause a transportation of the fluid; in microscopic movement, on the other hand, the particle is free to move, and the reaction of the liquid probably produces those movements which are visible in the microscope.

Although I have chiefly confined my attention to inorganic substances, I have also found that all organic solid particles which are sufficiently small exhibit the movements in a high degree. Albumen, dextrin, grape or cane sugar, starch solution, alcohol, &c., seem to have little or no power of destroying the motion, and the extraordinary properties of gum arabic have been noticed. I think it not unlikely that when these phenomena are fully investigated they will give strong support to a theory lately put forward by M. Becquerel, that the movements of fluids in animals and plants, which have often been attributed by Graham and others to osmose, are really due to minute electric currents.

MR. DANCER, F.R.A.S., stated, that the subject which Professor Jevons brought before the meeting, was one to which he had paid attention at intervals for the last thirty years. He had repeated Dr. Robert Brown's experiments with the majority of the substances named in his paper, and had also experimented with a great number of other substances and different solutions.

The particles approaching a spherical form gave evidence of the greatest activity, with some few exceptions. The activity and duration of the movements vary according to their magnitude and also the solution in which they are suspended. For instance, some of the metallic oxides would exhibit the movement for some time, and then gradually get aground on the glass plate, and cease to move. There was some difficulty in reducing metals to particles sufficiently small and regular in form for the exhibition of the molecular movement; even hardened steel, when rubbed on a very fine hone, appears fibrous, and soft metals, such as platinum and copper, like shavings, under a high magnifying power. Those siliceous particles of the hone which have their lines of cleavage favourably situated are frequently detached in thin plates during the act of grinding, and form brilliant objects when viewed by polarised light. Metals reduced in this manner require re-grinding several times before they lose their fibrous character, and become sufficiently minute for successful experiments.

Metallic oxides vary considerably in their form and magnitude, according to the solutions from which they are precipitated. By practice it would be possible, in many cases, by their microscopical appearance, to name the solutions from which they had been precipitated. The activity of these, when of favourable size, say from the 1-30000th to 1-50000th of an inch, is very different, being great in water, solution of gum, sugar, &c., but quite inactive in oil.

Mercury and sulphur when sublimed assume a spherical form, and although these spheres could be obtained from 1-1000th to 1-50000th of an inch in diameter, they do not exhibit any movement in water. He has sublimed them on to a drop of water, but they refused to sink. Possibly their polished surfaces retained a film of air which floated them. So transparent and perfect in form are the sulphur spheres that they distinctly exhibited the image of a lamp flame at their focal point. Triturated or precipitated sulphur will exhibit active movement in various solutions. As regards the cause of this so-called molecular movement, Mr. Dancer thinks that chemical action will not account for it. Diamond dust, graphite, and other refractory substances, are found to be active in water and solutions of gum. Nor is electricity a satisfactory explanation to him. He has found that particles did not show a marked alteration in their movements when exposed to electrical influence. The results of many experiments point to heat as a probable cause, and although the peculiar movements of these particles appear like electrical attraction and repulsion, similar movements might be caused by the changes of temperature of the particles transmitted through the solutions.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, January 31, 1870.

Dr. WILLIAM WALLACE, F.R.S.E., Vice-President, in the Chair.

Mr. JOHN CHRISTIE, of Alexandria Turkey Red Works, Dumbartonshire, read a paper on "*The History of Madder, the Various Investigations Relating to its Character and Composition, and the Proposed Sources of Artificial Alizarine.*"

The author, with considerable detail, traced the history of madder dyeing, from its origin in Eastern India, 3000 years ago, through Persia, to Adrianople, Greece, Italy, and Western Europe. The colours were first obtained from Munjeet; then came into use the Turkey madder root. This plant was first grown in England in 1624, at which time three qualities were known—cropp, fatt, and mill madders. In the year 1798 there were only eleven madder mills in the whole of France, while now in the department of Vaucluse alone there are no fewer than fifty in operation. French madder root has a peculiar smell, and a taste between bitter and sweet. Some kinds, as those of Alsace and Holland, when mixed with water and allowed to stand for some time, give a thick jelly; this is not yielded to the same extent by Avignon madder. If this madder is treated with an acid it produces a perceptible effervescence, owing to the quantity of calcic carbonate which it contains.

Towards the close of last century, scientific investigators and the more intelligent of the dyers and printers were led from various circumstances to suppose that madder contained two colouring matters, a red, and what they then called a tawny colour. The author mentioned the results of the investigations of Watt, Charles Bartholdi, and Hausmann, and stated that, in 1823, M. T. Kuhlman published a complete approximate analysis of madder. That chemist found a red colouring matter, which he specially searched for, and another matter of a fawn colour, which he did not consider worthy of investigation. He prepared the red colouring matter by steeping madder roots in water for twenty-four hours, then boiling the washed madder with a fresh quantity of water, filtering the decoction hot, and then adding sulphuric acid, when a flocculent precipitate of an orange colour was produced. He again filtered and washed the precipitate with acidulated water. What he thus obtained was his *matière colorante rouge*. This he purified by dissolving in absolute alcohol, to which a

small quantity of dry pulverised potassium carbonate was added; the alcohol acquired an intense crimson-red colour. After filtering and allowing the filtrate to evaporate spontaneously, he obtained small crystals like fern leaves, and having the following properties:—(1), Great solubility in alcohol, and imparting to it a beautiful red colour; (2), solubility in water, the colouring matter altering in the concentrated solution, and being precipitated; (3), the solubility in water greatly facilitated by alkalies without any material alteration of the shade; (4), it is precipitated as an orange colour from solutions by acids.

Mr. Christie next referred to the researches which were made on Alsace madder by Robiquet and Colin, and published in 1826. Those chemists obtained two colouring substances, one of them being what they considered no other than the particular colouring substance of madder, and which they named *alizarine*, from the modern Greek name for madder. The other substance they considered to be a modification of alizarine, and from the colour which it took when freed from the acid used to precipitate they called it *purpurine*. In the following year, by pursuing a somewhat different process, Gautier de Claubry and Persoz obtained two colouring matters—*matière colorante rouge* and *matière colorante rose*. Their distinctive properties are thus shown:—

Red.	*Rose.*
Fracture brilliant.	Fracture resinous.
Attacked by ammonia warm.	Attacked by ammonia cold.
Caustic alkalies give red colour.	Caustic alkalies give purple colour.
Insoluble in alum liquor.	Freely soluble in alum liquor.

In the hands of the same chemists madder yielded, by treatment with sulphuric acid, and subsequent washing with cold water, a preparation of great tinctorial power, which was at first called *sulphuric carbon*, and sometime later *garancine*. The manufacture of this substance on the large scale was undertaken by MM. Lagier and Thomas, of Avignon, in 1829.

The author gave a full outline of the investigations which Dr. Edward Schunck made in 1848. Seven substances were obtained by Schunck: two colouring bodies, two resins, a bitter substance, pectic acid, and a dark brown substance. One of the colouring bodies was alizarine, to which he gave the formula, $C_{14}H_{10}O_4$; for the other, which he named *rubiacin*, he proposed the formula $C_{32}H_{22}O_{10}$. Pursuing a different process, Dr. Debus, in the same year, investigated Zeeland madder. He called one of the colouring bodies *lizaric acid*, and proposed for it the formula $C_{30}H_{20}O_9$; and the other he called *oxylizaric acid*. Its composition was—

Carbon	66·40
Hydrogen	3·86
Oxygen	29·74
	100·00

The last mentioned substance was obtained to the extent of about 4 or 5 grains from 20 lbs. of madder.

Drs. Wolff and Strecker, pursuing a process very similar to Schunck's, obtained, in the year 1850, both alizarine and purpurine. The latter they regarded as oxide of alizarine. Their conclusions were summarised thus:—

I. Madder contains two colouring matters—alizarine and purpurine.

II. Alizarine changes into purpurine when madder is fermented.

III. Alizarine and purpurine, when oxidised with nitric acid, give phthalic acid.

IV. Chloronaphthalic acid is chloride of alizarine.

According to Strecker, if the formula of alizarine be taken as $C_{10}H_6O_3$, and one atom of chlorine be substituted for one atom of hydrogen, an interesting relationship is observable between that compound and chloroxynaphthalic acid, $C_{10}H_5ClO_3$. The author said it would thus seem likely that alizarine, or a body very similar to it, might be produced from chloroxynaphthalic acid. Schützenberger and Lauth have replaced the chlorine in that compound by hydrogen, but the new body had not the properties of alizarine, the composition of which, according to Schützenberger, is very probably $C_{20}H_{12}O_6$. P. and E. Depouilly, by boiling chloride of chloroxynaphthalic acid, $C_{10}H_5ClO_3.Cl$, with solution of potash, and subsequent treatment with mineral acids obtained as a yellow crystalline powder, a body which sublimed in beautiful needles, and whose alumina salt is a deep red, like the colour given by madder. The iron salt is nearly black, and although it resembles alizarine in many points, Schützenberger states that trials made at Mulhouse to use it had not been satisfactory.

The next point referred to in the history of alizarine was the fact that Dr. Anderson, of Glasgow, had treated opianic acid, $C_{10}H_{10}O_5 (= C_{10}H_6O_3 + 2H_2O)$, with sulphuric acid, and obtained a colouring matter which was probably alizarine, as it yielded all the madder colours on alumina and iron mordants. According to Clark, who obtained a patent for the process in 1861, artificial alizarine is obtained from dinitronaphthaline, and is capable of yielding all the madder colours. More recently Professor Rochleder, of Prague, has obtained, besides alizarine and purpurine, a small quantity of a colouring matter which reacts very like chrysophanic acid obtained from rhubarb root. When crystallised from absolute alcohol it has the composition $C_{14}H_{10}O_4$, and when it is distilled with powdered zinc it yields anthracen, $C_{14}H_{10}$. Graebe and Liebermann noticed that natural alizarine by distillation with powdered zinc, yielded a hydrocarbon which, instead of being naphthaline, $C_{10}H_8$, as they expected, proved to have the same composition as Dr. Anderson, Berthelot, and others had given to anthracen, and believing that this was the proper source to start from in the preparation of artificial alizarine, they set to work to test the truth of the opinion. They were so far successful that they obtained a product closely allied in many of its properties to the colouring matter of madder, and in December, 1868, they obtained provisional protection for their process in this country. Mr. Christie detailed the process, stating that the patentees obtain in the first stage of the process anthrachinon, $C_{14}H_8O_2$, by the use of bichromate of potassium—

$$(C_{14}H_{10} + K_2Cr_2O_7 = C_{14}H_8O_2 + 2KHO + Cr_2O_3),$$

In the second stage they convert the anthrachinon into bibromanthrachinon, $C_{14}H_6Br_2O_2$, a solid substance which is purified by crystallisation from benzol. In the third stage this new compound is transformed into artificial alizarine by treating with potash, heating to 180° or 260° C. till a deep blue colour results, then dissolving in water, filtering, and precipitating the alizarine by acid. They obtained provisional protection for a second patent last year.

Pursuing a somewhat different course, Julius Brönner and Hermann Gutzkow, of Frankfort-on-the-Maine, matured a process which they patented in May, 1869, and which, they state, yields two colouring matters that can be employed for dyeing or printing, either with or without mordants. One of them colours alcohol yellow, and the other colours it red or violet.

Mr. Christie completed his historical *resumé* by referring to Mr. W. H. Perkin's process, patented 26th of June, 1869, by which artificial alizarine is obtained from anthracene, by oxidising with bichromate of potassium to produce anthrachinon—a process which has recently been modified by the use of a new acid derived from anthrachinon in place of bibromanthrachinon.

The author then referred, at considerable length, to experiments which he had recently made with Perkin's artificial alizarine, and with one made by a secret process by M.M. Lucius and Co. of Hoechst, near Frankfort. Amongst other things, he stated that while natural alizarine, prepared from the finest garancine, fused at 320° F., and was almost entirely sublimed by exposure to a temperature of 340°, the artificial alizarine only yielded a sublimate when the temperature was raised to 420° F.

There was no fusion, and only 15 per cent of the powder was sublimed, even though it was kept at a temperature of 450° for a whole hour. No fusion ensued, and no further sublimate was produced, though the powder was slowly heated to 600°, at which temperature it was kept exposed for some time. Mr. Christie showed to the members an interesting experiment to demonstrate the truth of his opinion that artificial and natural alizarine are not identical. He placed swatches of dyed cloth in caustic soda solution (30 grs. to the gallon of water). Those dyed with the artificial alizarine of Perkin and Lucius and Co., in a short time threw off a deep crimson colour, which rose to the surface of the cloth, and, flowing down the swatch, fell in streaks through the alkaline liquor; while those dyed with natural alizarine and with garancine threw off no colour to affect the soda solution. He had found that selected crystals of artificial alizarine had only one-half the tinctorial power of the natural product. He concluded by saying that, from the several experiments which he had made, his opinion was that, although the substance now sold as artificial alizarine may be the best attempt to produce the alizarine of madder by chemical means, in its present state it is far from being identical with it.

A very animated discussion followed, in which Messrs. Anderson, Hogg, J. W. Young, Smith, Paterson, and the Chairman took part.

Mr. HOGG strongly combated the opinion that the two products are not identical. He questioned the absolute purity of Mr. Christie's artificial alizarine, and said that, unless it was not only sublimed, but several times recrystallised from alcohol, it would be impure; and, further, that the colouration imparted to the alkaline liquor was doubtless due to the presence of another colouring matter which is known to be present in ordinary commercial artificial alizarine. He also stated that mordanted cloth dyed with pure artificial alizarine stands soaping better than that dyed with garancine: that was the testimony of many persons who had worked with the colour.

Mr. J. W. YOUNG said that he had found that cloth prepared with the artificial alizarine would stand even boiling with soap.

Mr. SMITH stated that he considered that he had established the identity of the crystals of the two products by microscopic examination.

In proposing a vote of thanks to Mr. Christie, the CHAIRMAN referred to the highly interesting nature of the enquiry, and complimented that gentleman upon the extensive researches in which he had been engaged, as shown by his very elaborate paper. The proposal was most heartily agreed to.

CORRESPONDENCE.

THE BESSEMER PROCESS FOR MAKING STEEL.

To the Editor of the Chemical News.

SIR,—Mr Norman Lockyer, in his lectures upon the spectroscope, delivered a few weeks ago before the Society of Arts, stated that this instrument was of great service in directing the Bessemer process of making steel; I have, however, been informed by others that it is perfectly useless for this purpose, since it does not afford any indication denoting that the blast has been kept on for a sufficient length of time.

Perhaps Mr. Lockyer, or some other gentleman, will kindly publish sufficient of his *practical experience* to settle this question. Such an act of courtesy will oblige both your correspondent and many other students.—I am, &c.,

A. B.

MISCELLANEOUS.

Sweating Gold Coins.—The trial of Clifford for sweating gold coin presents many points of interest. It is the first case of the kind for thirty years. The facts were as follows:—The attention of the police being directed to a number of light sovereigns that found their way into circulation in a certain district, the coins in question were traced to a little girl, who, it appeared, acted for her father. When Clifford was arrested, he was seated in front of a battery, and although he may not have been working at the moment, still two sovereigns, each light to the extent of nearly two shillings, were found in his pocket. The scientific witness, Mr. W. Chandler Roberts, clearly showed that the wires that had sustained the sovereigns in the decomposition trough had been attached to the positive or dissolving electrode, and that the battery had not been employed for electro-gilding. Clifford threw into the fire the contents of a tea-cup, and as the chemist of the Mint produced in court gold extracted from the cinders, it is probable that the fluid was the actual solvent employed. Commenting on this, the *Pall Mall Gazette* says:—"In an official report bearing the signatures of the late Master of the Mint and Colonel Smith, F.R.S., it was suggested that a Mint charge should be imposed upon gold coin sufficient to defray not only the first cost of manufacture, but also the expense of replacing the worn coin after a certain period by new pieces of standard weight. It was proposed that as a coin would fall below current weight in eighteen years, it should be brought to the Mint at the expiration of that period and exchanged for a new piece. The recent trial of Clifford for 'sweating' sovereigns by the aid of an electric battery, and more especially the evidence of the scientific witness as to the facility with which such an operation can be carried out, suggests that if the plan in question were adopted, a positive bribe would be offered to ingenious but dishonest individuals to tamper with the coinage, and then present the damaged coin for exchange at the Royal Mint."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, January 31, 1870.

This number contains the following papers relating to chemistry and sciences allied thereto:—

Observations on the Process Applied by M. Adams to Produce Deposits of Nickel on Other Metals.—M. Gaiffe.—The main gist of this paper is to prove that, whatever may have been the value of the scientific experiments made on the electro-deposition of nickel upon other metals by various scientific men, none of them have succeeded in establishing an industrially-available method for the electro-deposition of nickel upon other metals; and the author states that this part of the discovery is entirely due to M. Adams.

Transformation of Octohedric Crystallised Sulphur into Insoluble Sulphur under the Influence of Light.—M. Lallemand.—It is, the author says, a well-known fact, that M. Schroetter, of Vienna, proved that the action of sunlight converts ordinary phosphorus into red amorphous phosphorus. Sulphur, according to this author, is similarly affected by the direct action of sunlight, inasmuch as the sulphur, previously soluble in sulphide of carbon, and crystallisable, is converted into an amorphous modification insoluble in sulphide of carbon. The author placed a concentrated solution of

sulphur in the liquid just alluded to in a sealed tube, and exposed that tube some time to the action of the sun's rays, concentrated by a lens; this causes a copious precipitation of sulphur as an amorphous insoluble matter.

Action of Magnetism upon Rarefied Gases.—M. Daniel.

Heat Evolved when Boron Combines with Chlorine and Oxygen.—MM. Troost and Hautefeuille.—According to the authors, carbon, when combining with oxygen, only gives out 8000 caloric units; boron, under the same conditions, yields 14,400 caloric units; while, when boron combines with 3 equivalents of chlorine, 104,000 caloric units represent the heat set free.

Mode of Division of a Limited Quantity of Acid between Two Bases Applied in Excess.—M. Landrin.—The author has experimented with nitric acid and the oxides of zinc and lead; the average percentage result arrived at is—Oxide of zinc, 29·93; oxide of lead, 20·49; nitric acid, 49·58. As regards the manner of distribution of the nitric acid employed, the author finds that there exists the relation of 1 to 4—that is to say, that, for 1 equivalent of dissolved oxide of lead, there have been dissolved 4 of oxide of zinc.

Electrolysis of Oxalic Acid.—M. Bourgoin.—A lengthy paper on the electrolysis of oxalic acid. The main point of interest is that the group $C_2O_3,3HO$ suffers decomposition only.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19, 1869.

This number contains the following original papers and communications:—

On Anthracen-Carbonic Acid.—MM. Græbe and Liebermann.—When anthracen is heated, along with liquid phosgen, in sealed tubes, no action takes place until the temperature is raised to 180°, and the full reaction is only obtained by continuous heating to 200°. The result of this operation is the formation of anthracen-carbonic acid, $C_{14}H_9.COOH$; this substance is almost insoluble in cold water, but can be obtained in crystalline state from its boiling-hot solutions in that fluid; the acid fuses at 206°, but loses some of its carbonic acid at 150°. The salts of this acid are soluble in water and alcohol; when the acid is submitted, while in solution in anhydrous acetic acid, to the oxidising action of chromic acid, anthrachinon is formed.

Synthesis of Indol.—MM. Baeyer and Emmerling.—In a lengthy paper, the authors describe the formation of indol, synthetically, from nitro-cinnamic acid, according to the following formula:—

$$C_6H_4\begin{cases}-NO_2\\-CH=CH-COOH\end{cases} \quad -CO_2-O_2=C_6H_4\begin{cases}-CH\\ \|\\ CH\\ |\\ -NH\end{cases}$$

Azocinnamic acid, obtained by treating nitro-cinnamic acid with sodium amalgam, also yields indol when it is treated with an oxidising substance like, as for instance, peroxide of lead.

Formation of Nitro Bodies (Nitrosokörpern).—M. Baeyer.—The author states that only such nitrogenous substances as contain the imido group, NH, are capable of yielding, with nitric acid, nitro bodies or compounds. It is further to be observed that only such imido compounds as exhibit a basic character yield nitro derivatives, and quotes, as instances, that, whereas isatine and succinimide do not yield such nitro compounds, diethylamine, diglycolamidic acid, coniine, and other substances do. The paper discusses, at length, the *modus quo* and the origin of these combinations, and the relative position of the nitro group.

Reduction of Angelic Acid to Valerianic Acid.—M. Ascher.—When angelic acid is heated to about 200°, along with hydriodic and amorphous phosphorus, for about eight hours, it is entirely thereby converted into valerianic acid, as was fully proved by the elementary organic analysis of the silver and baryta salts of the last-named acid.

Contribution to the Knowledge of Xylidine Derivatives.—M. Genz.—Starting with perfectly pure xylidine, the author prepared:—Acetxylidide—

$$C_{10}H_{13}NO=\left\{\begin{matrix}C_8H_3\\C_2H_3O\\H\end{matrix}\right\}N,$$

a solid substance, which fuses at about 173°, is readily soluble in alcohol and ether, and capable of crystallisation. Aceto-monobrom-xylidide—

$$C_{10}H_{12}BrNO=\left\{\begin{matrix}C_8H_2Br\\C_2H_3O\\H\end{matrix}\right\}N,$$

also a solid substance. Mexylidine, or dixylyl-guanidine—

$$C_{17}H_{21}N_3=\left\{\begin{matrix}Civ,\\(C_8H_9)_2\\H_2\end{matrix}\right\}N_3,$$

a solid crystalline substance, difficultly soluble in water, readily soluble in alcohol and ether, combining, with chloride of platinum, to a salt—

$$2(C_{17}H_{21}N_3,HCl).PtCl_4.$$

Appendix to the Contributions on the Products of Desulphuration of Diphenyl-Sulpho-Carbamide.—Dr. A. W. Hofmann. Too concisely written to admit of useful abstraction.

Relation of Triphenyl-Guanidine to Sulphide of Carbon.—M. Hobrecker.—

$$\underbrace{C_{19}H_{17}N_3}_{\text{Triphenyl-guanidine.}} + \underbrace{CS_2}_{\text{Sulphide of carbon.}} = \underbrace{C_{13}H_{12}N_2S}_{\text{Diphenyl-sulpho-carbamide.}} + \underbrace{C_7H_5NS.}_{\text{Pheny essential oil of mustard.}}$$

The reaction proceeds further according to the following formula:—

$$C_7H_5NS+2H_2O=C_6H_7N+H_2S+CO_2.$$

Avogadro's Law, as Derived from the Mechanical Theory of Gases.—M. Naumann.—An algebraico-chemical essay.

On Chloro-Phenol-Sulpho Acid.—M. R. Bähr-Predari.—The author describes, at great length, several compounds obtained by him; the chief substance is a potassium salt, $C_6H_4ClKSO_4+2H_2O$, losing, at 110°, its water of crystallisation, fusing at 245°, and becoming decomposed at 300°.

Determination of the Mineralogical Formula of some Mixed Rhombohedrical Carbonates.—M. Cossa.—This paper treats on the question whether, in such substances as dolomite, mesitine, and others, the carbonates of lime and magnesia, and of protoxide of iron and magnesia, are simply mixed or are chemically combined. The paper, however interesting in many respects, is too lengthy and too full of formulæ for useful abstraction.

Incorrectness of the Thermo-Chemical Estimations and Researches made, by means of the Mercurial Calorimeter, by MM. Favre and Silbermann.—M. Thomsen.—Chiefly a series of tabulated formulæ and figures.

Methods of Distinguishing Molecular Compounds.—M. Rathke.

Molecular Weight of some Protoxide Combinations.—M. Ladenburg.

Third Paper containing the Results of the Researches on the Ethereal Derivatives of Acids and Alcohols.—M. Henry.—Among a series of different products, the author describes, chiefly, monochloro-methyl-phenol, $C_6H_4Cl(CH_3O)$, a very mobile fluid, insoluble in water and in caustic alkaline liquids; soluble in alcohol and ether; sp. gr. at 9°, 1·182; boiling-point, 200°. Monochlorethyl-phenol, $C_6H_4Cl(C_2H_5O)$, also a liquid, boiling at 210°; sp. gr. at 9°, 1·106. Monobromo-methyl-phenol, $C_6H_4Br(CH_3O)$, a liquid boiling at 220°; sp. gr. at 9°, 1·494.

Some Reactions of Anhydrous Sulphuric Acid, and a New Method of Formation of Oxysulphide of Carbon.—M. Armstrong.—After referring to the labours of MM. Schützenberger, Rose, and Williamson on this subject, the author describes a series of experiments made with anhydrous sulphuric acid and sulphide of carbon, equivalent parts of which substances having been mixed and heated on a water-bath, give rise to the formation of oxysulphide of carbon and sulphur, according to the following formula:—

$$CS_2+SO_3=COS+SO_2+S.$$

Specific Heat of Gases, and the Correct Capacity for Heat.—M. Horstmann.—An algebraico-physical monograph.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, November and December, 1869.

These two papers, published together, contain the following original papers and memoirs:—

Detection and Estimation of Arsenic in the Rosaniline (Fuchsine) of Commerce.—Dr. Riecker.—This very lengthy paper is essentially devoted to the testing of the correctness of the methods for the quantitative estimation of arsenic, and the possibility of the quantitative estimation of arsenious and arsenic acid separately, when both these substances are present. As regards the qualitative detection of arsenic in fuchsine, the author states that the pigments of that name tested by him, and obtained from various sources, all contain arsenic in some form or other. That this quantity is not small may be inferred from the results of the author's quantitative analysis, from which we gather that a sample of fuchsine obtained direct from a manufacturer contained, on an average, 2·073 per cent of arsenious acid and 7·593 per cent of arsenic acid. Another sample, obtained from a wholesale drysaltery, contained, on an average (several analyses were made), 1·008 per cent of arsenious acid and 4·4705 of arsenic acid. This research was undertaken with the express view of testing the question, whether the use of fuchsine, as a colouring matter for syrups, sweetmeats, and the like, is or is not to be prohibited, as can be done in Prussia by a simple police order. It is quite evident that fuchsine should not be indiscriminately used for such purposes.

Easy Method of Removing Gypsum from Water.—Dr. Riecker.—The use of witherite, native carbonate of baryta, is recommended by the author to remove all the gypsum from water. Of course the quantity of the mineral to be applied for this purpose should be regulated according to the quantity of gypsum present in the water; but, as an instance, we may state that a water containing, in 10,000 parts, 4·37 parts of gypsum, requires about ½ lb. of witherite, ground to a fine powder, for every large pailful of that water. After the addition of the witherite, the water is well stirred, and next left at rest to deposit the sediment for twenty-four hours, and then run off for use. The water may be either boiled before or after this process, and will be found quite soft.

Proper Arrangements of Pumps so as to Yield a Pure and Wholesome Potable Water.—Dr. Riecker.—Attention is called to the necessity of excluding from pumps any surface, or drainage, or sewage waters, and to bore the wells to such a depth as to be out of the reach of such contaminations of the water to be used for domestic and industrial purposes.

Cosmos, February 5, 1870.

Investigation of the Grotto of Montesquieu-Avantès (Ariège, France).—M. Regnault.—The researches made by this author of the locality alluded to, lead him to agree with MM. Vogt, Broca, Strenstrup, and other *savants*, as to the anthropophagic nature of primeval man.

Atmospheric Electricity of Haiti.—M. Ackermann.—The island of St. Domingo, as it is also called, is situated between 17° 53′ and 19° 58′ N. latitude, and between 70° 45′ and 76° 55′ latitude W. from Paris. According to the author, who has, during a series of five years, made meteorological observations at Port au Prince, there have, on an average, been 129 days of each year either severe thunderstorms, or other very marked electrical phenomena, especially during the months of May, July, August, and September. Severe thunderstorms more frequently occur during day- than night-time. The year 1868 was especially remarkable for severe thunderstorms; during one of these, lasting for forty-five minutes, 400 lightning flashes were distinctly seen.

Pharmaceutische Zeitschrift für Russland, November, 1869.

This number contains the following original papers and memoirs relating to chemistry:—

Monograph on Inuline.—Dr. Dragendorff.—Continued from former numbers. This exhaustive paper is not yet ended.

Preparation of the Amides of Polybasic Acids.—Dr. Lösch.—The author prepared tartramide, citramide, and succinamide, by causing liquid ammonia to act upon the ethers of the acids referred to. The chief result of the author's researches on this subject is that, by the action of liquid ammonia (in aqueous solution), just alluded to, the neutral amides of the acids are only formed for a moment; but decomposition sets in, and other compounds result from the reaction, and it is, therefore, necessary to act upon the ethers referred to with an alcoholic solution of ammonia-gas when it is desired to obtain the amides of the acids.

Artificial Kirschwasser.—M. Reinsch.—The genuine alcoholic fluid of this name owes its flavour to the presence of a small quantity of hydrocyanic acid and ethereal oil of bitter almonds (hydruret of benzoyl). The author suggests that, when a certain quantity of the young leaves of the peach tree (a handful is named) is beaten up in a porcelain mortar, next digested with 4 litres of water during two days, and this mixture added to 2 litres of strong alcohol (94 per cent), and submitted to distillation, and the distillate diluted with water to a strength of 60 per cent alcohol, a fluid is obtained fully equal in taste and aroma to the best Swiss kirschwasser made from cherries bruised up with the stones and kernels they contain. The author cautions against the drinking of too large quantities of this liquor; and so he may, since cases of accidental poisoning with this and similar alcoholic liquors (Persico among the number) are by no means rare.

Moniteur Scientifique, No. 315, February 1, 1870.

This number contains the following original papers relating to chemistry and subjects allied thereto:—

Direct Application of Wool-Suint (Fatty Matter containing a large quantity of Potassa Salts) to the Preparation of Prussiates and Cyanides.—M. Havrez.—Suint contains some 40 per cent of potassa; and, when previously ignited, this alkali becomes thereby intimately mixed with strongly-nitrogenised animal charcoal. The author chiefly points out the profit to be derived from the use of suint for the manufacture of prussiates and cyanides, and to the paper is added a short report from M. Schattenmann, prussiate and cyanide manufacturer, at Bouxwiller, near Strasburg, who states that results of experiments made with suint by him, on the large scale, are decidedly favourable to the use of that substance for the purpose alluded to. It should be observed that the quantity of suint contained in raw wool amounts to one-third of its weight; and the author states, in a foot-note, that, since in 1867 there was imported into the United Kingdom 63,000,000 of raw wool from the Cape and Australia, the quantity of suint contained therein amounted to at least 20,000,000 kilos.

Latent Heat of Volatilisation of Liquids.—M. Koehler.—An algebraico-physical treatise.

Artificial Alizarine.—M. Kopp.—The author points out that there are at present several processes of preparation of alizarine by artificial means, which are entirely different from each other. After mentioning MM. Græbe and Liebermann, and Gutzkow and Broenner, the author states that Dr. Grieff, at Cologne, has just come forward with an entirely new process, which will be tried on the large scale by MM. Weiler and Co., of that city. Reference is made to the fact that the purified alizarine (artificially made by MM. Meister and Lucius) yields, on elementary analysis, in 100 parts—Carbon, 69·92; hydrogen, 3·34; oxygen, 26·74. The formula $C_{14}H_8O_4$, by some assigned to alizarine, requires, percentically—C, 70·00; H, 3·33; O, 26·67. The author enters, at some length, into the question, whether artificially-made alizarine, even if it be cheaply and abundantly produced, will prove, in all respects, a suitable substitute for madder, and comes to the conclusion, for good and sound reasons (too many to quote here, but which we fully endorse), that the very composition of madder is such as to ensure its continued use, and even preference above any of its single tinctorial elements, because the effects produced by madder and its commercial preparations are due to the joint action of all its tinctorial and some one or more of its other constituents.

Soluble Iodine Green.—MM. Kalle and Co. write from Biebrich, Nassau, Prussia, stating that they have succeeded in producing an iodine green soluble in tepid, and even cold water, without difficulty. This new material, moreover, does not contain picric acid, and, being less acid, does not require silicate of soda, for which borax is to be substituted. This dye yields so fast a colour that woollen tissues can be fulled after dyeing with it.

Polytechnisches Journal von Dingler, first number for December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Experiments made with the view to Determine Percentically the Value of Fire-Clays.—Dr. Bischoff.—In a lengthy paper, the author records a series of pyrometric experiments made with the view of ascertaining the value of such substances as pure silica, alumina, and mixtures of the same, in respect to resistance of fusion, and, also, of various native mineral products, known by different names and of very different mineralogical and chemical characters.

Second number for December, 1869.

Preparation of Ferricyanide of Potassium, or Red Prussiate.—M. Reichardt.—The author recommends the use of bromine, instead of the usual application of chlorine, to convert the ferrocyanide of potassium (yellow prussiate) into ferricyanide. 422·28 grms. of crystallised ferrocyanide require 79·97 = 80 of bromine = 100 : 19 = *circa* 6·33 c.c. The formula is—

$$2(2KCy+FeCy+3HO)+Br=3KCy+Fe_2Cy_3+KBr.$$

Experiments made, on the small scale, with 50 grms. of ferrocyanide, proved that 9·5 grms. of bromine were required; and the operation is very rapidly finished. The author states that experiments made on the large scale answer exceedingly well.

Chemical Analysis of a Sample of Extract of Meat.—M. Reichardt.—This sample was prepared by a private firm, and yielded, on analysis, the following results:—Portion soluble in alcohol (of 83 per cent strength), 80·76 per cent; water, 16 per cent; fatty matter, 0·2 per cent; nitrogen, 9·99 per cent; ash, 21·36 per cent (containing potassa, 9·0 per cent; soda, 2·3 per cent; phosphoric acid, 6·1 per cent. These results, as compared with Liebig's and the Fray Bentos extracts, are stated by the author to be in favour of the extract tested by him for MM. Buschenthal and Co.

First January number, 1870.

Substances Suitable to Agglutinate Coal-Dust.—M. Jicinsky.—This paper is a valuable contribution to the proper methods of utilising coal- and coke-dust and small coals, and the manufacture of artificial fuel, but cannot be understood without reproduction of the engravings.

Analysis of Pig-Iron.—M. Richter.—The sample was obtained from a peculiar iron ore met with in Silesia. The sp. gr. of the iron = 7·361. It contained in 100 parts:—Iron, 90·041; copper, 5·343; cobalt, 0·666; nickel, a trace; arsenic, 0·013; silicium, 1·644; phosphorus, 1·464; sulphur, 0·404; combined carbon, 0·723; no molybdenum.

Revue Hebdomadaire de Chimie, January 20, 1870.

Analysis of Some Extracts of Meat as met with in Commerce.—M. Lebaique.—The number above quoted contains the results which we reproduce here; but a full account of the method of analysis employed is recorded in two previous numbers—viz., those of December 23rd and 30th. The author distinguishes the extracts by the figures A, B, C, D, and E, referring, respectively, to—Liebig's meat extract; La Plata extract; extract from M. Tooth, Sydney; extract of French Company in South America; extract of M. Whitehead, Sydney. Organoleptic, or physical properties of the extracts:—A. A firm, homogeneous, yellow-coloured substance, perfectly soluble in water, yielding a brown-coloured solution, and exhibiting a strongly-pronounced smell as well as taste, contains 7·5 per cent of water, 61·2 per cent of substances soluble in alcohol, 23 per cent of ash, and a total of 9 per cent of nitrogen.—B. (Two samples.) No. 1 is a somewhat soft, homogeneous, brown-coloured substance, imperfectly soluble in water (insoluble residue amounts to 2·5 per cent); the aqueous solution is brown-coloured, and exhibits a strong animalised smell and taste; it contains 9·0 per cent of water, 53 per cent soluble in alcohol, 21 per cent of ash, and a total of 9 per cent of nitrogen. No. 2 is a soft, brown-coloured, homogeneous substance, soluble in water, without residue, brown-coloured solution, odour and taste rather strong; it contains 16 per cent of water, 53 per cent soluble in alcohol, 18 per cent of ash, and a total of 9·6 per cent of nitrogen.—C. A soft, light brown-coloured, non-homogeneous substance, only imperfectly soluble in water (insoluble residue, 3 per cent); the aqueous solution is light brown-coloured, and odour and taste are rather strong; it contains 15 per cent of water, 54 per cent soluble in alcohol, 21 per cent of ash, and a total of 8·4 per cent of nitrogen.—D. A hard brown-coloured granulous substance, imperfectly soluble in water (1·5 per cent of insoluble residue); colour of aqueous solution, bright brown; taste and odour less strongly marked than that of the other samples; it contains 16·5 per cent of water, 28 per cent of matters soluble in alcohol, 9·5 per cent of ash, and a total of 10·7 per cent of nitrogen.—E. A soft, homogeneous, light brown-coloured substance, soluble in water without leaving any residue; colour of solution, brown; smell and taste, rather strong; it contains 17 per cent of water, 47 per cent of matter soluble in alcohol, 19 per cent of ash, and a total of 9·46 per

cent of nitrogen. The alcol ol applied contained 90 per cent of absolute alcohol.

Chemical Investigation of the Apples suitable for Cyder Making.—M. Mène.—It appears that there has been held, at St. Lô (Brittany, France), a mixed congress, of scientific men and agriculturists, who have investigated this subject. The method of analysis, and the divers means employed to ascertain the following particulars, viz., sp. gr. of the juice, dry glucose, dry mucilage, tannin, free malic acid, divers malates, and water, are given at great length; and a tabulated form records the results obtained by the analysis of some twenty-four kinds of apples, stating the constituents for 1000 parts. The lowest sp. gr. of the juice has been found at 6·5, the highest at 11·7; smallest quantity of glucose, 122·0, highest, 194·0, for 1000 parts.

New Reagent for the Estimation of Carbonic Acid in Combination in Bicarbonates and in Natural Waters.—M. Lory.—The author employs phosphate of copper dissolved in a very slight excess of hydrochloric acid; the phosphate of copper is obtained by precipitating a solution of bichloride of copper with ordinary phosphate of soda. The precipitate is collected on a filter, well washed, and, after having been taken from the filter, suspended in water and dissolved by the addition of a few drops of hydrochloric acid. When this reagent is added to any water containing alkalies or alkaline earths in the state of carbonates or bicarbonates, the result is, at first, the formation of a bluish coloured cloudiness, or turbidity; by the addition of a larger quantity of this reagent, this turbidity disappears, and the liquid becomes clear again. This point having been reached, the quantity of the reagent applied will be proportional to the total equivalent of the bases present, and, consequently, to the carbonic acid which was combined with these bases. In order to titrate the reagent, dissolve 0·265 grm. (equal to 1-200th equivalent) of perfectly pure and dry carbonate of soda in water, and saturate this solution with carbonic acid, in order to convert it into bicarbonate (excess of carbonic acid does not at all affect the reagent). 4·4 c.c. of this solution upon 1 decilitre of pure water should produce, by the addition of the copper liquor, the reaction already alluded to, and these 4·4 c.c. correspond to 0·220 grm. of carbonic acid.

January 27, 1870.

Manufacture of Hyposulphite of Soda with Alkali Waste.—M. Mène.—Sulphate of soda is added to the alkali waste, which is spread out in regularly-formed heaps, or beds, and this mixture is left to the action of atmospheric air; the soda-salt alluded to is decomposed, and there is formed a large quantity of hyposulphite, which makes its appearance in the shape of efflorescences. When this has increased to a certain point, the mass is treated with water, and the aqueous solution is next treated with a weak acid, in order thereby to eliminate salts of lime and some sulphides. This latter operation also produces sulphur, since the sulphuretted hydrogen which is given off may be utilised.

Useful Application of Mica.—M. Mène.—In Germany, the doors of the steam-boiler furnaces are now very generally provided with square pieces of mica, properly fastened, by means of which the fireman is enabled to observe the fires without the necessity of opening the furnace doors too frequently, which is injurious, on account of interfering with the draft and proper course of combustion of the fuel, by reason of the access of irregular currents of cold air. Mica withstands a very high temperature, and the accidental breakage of these squares, or panes of this substance is thus inserted is guarded against by a properly-constructed iron wire-guard outside.

Electrical Pyrometer.—M. Becquerel.—Without reproduction of the cuts, this paper is not available for abstraction.

Les Mondes, February 3, 1870.

Artificial Caoutchouc.—M. Granier.—This material is a mixture containing gelatine and a variety of other substances (not specified) producing a homogeneous elastic substance, insoluble in mineral, as well as vegetable essential oils; not acted upon, moreover, by either coal or other hydrogenised gases. This material is now employed in France for a variety of purposes, too many to be here enumerated; its cost is only 3 francs per kilo.; and it melts readily at 100°, without decomposition, and can be cast into different moulds. Neither cold nor heat affect this substance, which, when completely oxidised, becomes more infusible than vulcanised caoutchouc.

Crystallisation of Diamond, Rock-Crystal, and Tribasic Phosphate of Lime by means of Cold.—M. Collas.—The author begins his paper with the following statement:—"The last of the subjects just mentioned is an accomplished fact; the second (speaking of rock-crystal) has been only half attained; and the first is, as yet, a hypothesis." The gist of the paper, which contains a lengthy description of experiments, may be summarised as follows:—The hydrate of the basic phosphate of lime becomes horny by desiccation, pulverulent on being boiled, and crystalline by congelation. The precious-stones, which contain cavities filled with a liquid, are crystallised hydrates, and the liquid alluded to is a remnant of the water of the hydrate. A hydrate crystallises in a manner different from that of the crystallisation of a saturated saline solution. The crystallisation of a hydrate by cold (freezing) is a dissociation; the hydrated substance precipitates entirely in crystalline state. Lastly, the author states that it is a contradiction, so to say, to try to obtain crystallised carbon (diamond) by means of heat. The author's opinion concerning this crystalline carbon is that, at a very remote period of the existence of our globe, hailstorms of diamonds have taken place. And to the paper a map is added indicating, by means of a curved line, the *cercle diamantaire*—*i.e.*, the area within which diamonds are now to be found. Graphite is, according to the author, destroyed diamond—that is to say, diamond which has lost its crystalline state.

Pre-Historic Man.—M. Capellini.—The author has explored a grotto in the island of Galmeria, Italy, and found human and animal bones, mixed up with flint instruments, and several objects undoubtedly made by men. This grotto is so situated as to make its exploration not only difficult, but dangerous; yet it appears, according to the author, to have been inhabited, since traces of a fire-place were discovered therein.

MEETINGS FOR THE WEEK.

MONDAY, 14th.—Geographical, 8.30.
—— Medical, 8.
—— London Institution, 4.
TUESDAY, 15th.—Royal Institution, 3. Professor Humphry, "On the Architecture of the Human Body."
—— Institution of Civil Engineers, 8.
WEDNESDAY, 16th.—Society of Arts, 8.
—— Meteorological, 7.
THURSDAY, 17th.—Royal Institution, 3. Prof. Odling, "On Chemistry."
—— Royal, 8.30
—— Zoological, 4
—— Chemical, 8.
—— Royal Society Club, 6.
FRIDAY, 18th.—Royal Institution, 8. Mr. Clifford, "Theories of the Physical Forces."
—— Geological, 1. Anniversary.
SATURDAY, 19th.—Royal Institution, 3. Mr. Max Müller, "On the Science of Religion."

TO CORRESPONDENTS.

*** With the present number, our subscribers will receive, in a convenient form for constant reference, a copy of the Regulations for the Sale and Dispensing of Poisons required by the "Pharmacy Act, 1868." The Pharmaceutical Society have the power to compel a strict compliance with the requirements of the Act; and we are glad to find that the Council are losing no opportunities of explaining to those concerned the conditions under which poisons can be legally sold or dispensed.

Joseph Welch.—A work, by the Editor of this journal, treating on the madder extracts and pigment colours is in the press.

March.—It cannot be made. (2) The various processes for the manufacture of artificial alizarine are all patented. (3) Messrs. Walker's address is 43, Mansell Street, Aldgate, E.

George E. Davis, Rev. E. Smith, Professor Smith (Sydney), Professor A. M. Thomson (Sydney), J. Gulson Burgess, and J. W. Slater. These correspondents are thanked for their communications, which shall receive due attention.

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THE CHEMICAL NEWS.

VOL. XXI. No. 534.

ON SOME

REMARKABLE SPECTRA OF COMPOUNDS OF ZIRCONIA AND THE OXIDES OF URANIUM.*

By H. C. SORBY, F.R.S.

WHEN a scientific man has been led into an error, and afterwards discovers his mistake, I think it a matter of duty that he should take an early opportunity to correct it. I therefore now write the following notice of certain remarkable peculiarities in the spectra of some compounds of the oxides of uranium with zirconia, which led both myself and others† to conclude that they were due to a new elementary substance.

Though the spectra of the different salts of those bases which show well-marked absorption-bands often differ in detail, yet they usually resemble each other so much that there is no difficulty in recognising each particular element. This is so constantly the case in the various compounds of erbium, didymiun, and cobalt, and in the ordinary salts of uranium, that, for a long time, the more I studied this question, the more did it appear to be a general rule; and there seemed to be no reason to suspect that a few special compounds of uranium would give spectra with absorption-bands as unlike as possible those of all others. Such, however, turns out to be the fact, when its oxides are combined with zirconia.

As an excellent illustration of important differences in mere detail, but general correspondence, I would refer to the spectra of didymium in different states of combination,‡ and would especially refer to the the most distinct of the numerous absorption-bands, which occurs in the yellow. The various compounds agree in showing this band in the same general position; but, by careful management, and by the use of sufficient dispersive power, it may be resolved into a very variable number of narrow bands or black lines. For example, in the case of the crystallised sulphate containing comparatively little lanthanum, it can be resolved into seven narrow lines, two of those near the centre being the darkest; whereas, when much lanthanum is present, one line on the side next the green is so much darker than the rest, that the others are comparatively absent. On fusing the mixed oxides with borax, the same spectrum is seen as with oxide of didymium alone, and I can resolve the above-named band into only two narrower bands; whereas, when the saturated bead is made to deposit crystals by being kept some time at a very dull red-heat, this band can easily be resolved into eight equal and very distinct black lines. Although these and similar differences, in detail, are of much interest, yet in no case are they so considerable as to prevent our recognising at once that the spectra are all due to didymium. It is also important to notice that the amount requisite to give a most splendid spectrum, when the bead is crystalline, will scarcely show any trace of bands when in a vitreous condition, dissolved in the borax. This is analogous to what occurs in the case of solid and powdered crystals of sulphate of didymium; for the absorption-bands in the spectrum of the light transmitted by a thin layer of the fine powder, strongly illuminated from the other side, are as distinct as in that transmitted by a many times greater thickness of solid and transparent crystal. We may very conveniently take advantage of this fact in studying the spectra of such substances when the amount of material at command is otherwise too small. This seems to be because the transmitted light does not simply pass through the crystals, but is in great measure reflected from them backwards and forwards, and thus, as it were, passes through a greater thickness. It is also to a considerable extent similar to that reflected from the powder when illuminated from above, as may be clearly proved by what occurs in the case of uranic salts. These, when in a state of moderately fine powder, transmit light giving a spectrum showing not only the absorption-bands in the blue, which alone are met with in that transmitted by a clear crystal, but also those in the green, which depend on fluorescence, characteristic of that reflected from the powder.* These two kinds of bands can be easily distinguished by means of a plate of deep-blue cobalt glass, which has an entirely different action according as it is placed below or above the object, when the bands are due to fluorescence, but has no such effect when they are due to ordinary absorption. It would, perhaps, be well to mention here that I have in this manner proved that the abnormal bands seen in the spectra of the compounds of zirconia with the oxides of uranium, described in this paper, are due to genuine absorption, and not to fluorescence.

The remarkable spectrum of some jargons has been already described by me in the CHEMICAL NEWS (vol. xix., p. 122) and in the *Proceedings of the Royal Society* (vol. xvii., p. 511). One of its most striking peculiarities is that, when light passes in a direction perpendicular to the principal axis of the crystal, and the spectrum is divided by means of a double-image prism into two spectra, having the light polarised in opposite planes, though some of the absorption-bands are of equal intensity in both images, yet others are comparatively absent, some in one and some in the other; whereas, in the case of other dichroic crystals which give spectra with absorption-bands, they are usually all more distinct in one image than when the light is not polarised, and all fainter, or even comparatively absent, in the other. No sooner had I observed this spectrum than I made various experiments in order to ascertain whether uranium was present or not; and the then known tests that could be applied to the amount of material at my command seemed to show that it was absent. This was quite in accord with the results of the various analyses published by other chemists, none of whom mention the existence of any trace of that substance. Moreover, the general character of the spectrum was entirely unlike that of all the known compounds of uranic oxide. The various artificial salts all agree in giving a variable but small number of moderately broad absorption-bands in the blue end; and the same is also seen in the case of several natural minerals; whereas the jargon gave a most unusually large number of narrow black lines (fourteen quite distinct, besides others more faint and a single broader band which I cannot separate into lines), extending from the red end; so that nearly all occur in that part of the spectrum which is entirely free from bands in all previously-known compounds of uranic oxide. This same general fact was also seen in the spectrum of the opaque blowpipe beads gently flamed, as described in my former paper.

I will not now enter into a description of the various chemical and physical facts which seemed to warrant the conclusion that zircons sometimes contain a new earth; but, taking these into consideration, there seemed to be every reason to believe that spectra which thus differed so much from those of any previously-known substance were characteristic of this new earth. Judging from the facts then known, it was more probable that spectra of such a new type were due to a new element than that they were due merely to a combination of two such elements as zirconium and uranium. Some of these chemical and physical

* Read before the Royal Society, February 10th, 1870. Revised by the Author for the CHEMICAL NEWS.

† Professor Church's paper, CHEMICAL NEWS, vol. xix., p. 121, and Professor Loew, vol. xx., p. 9.

‡ See also Bunsen's paper, *Pogg. Ann.*, vol. cxxviii., p. 100.

* See Stokes's papers, *Phil. Trans.*, 1852, p. 463, and 1853, p. 392.

facts can now be explained by the presence of uranium; but, besides this and several of the more common earths and oxides, I have detected, in some zircons, erbium, didymium, yttria, and another substance, which exists in such small quantity that I have not yet been able to ascertain whether or no it is the suspected new earth. These accidental constituents do not, indeed, occur in sufficient quantity to be of importance, except as modifying the physical and optical properties, the didymium giving usual characteristic absorption-bands (zircons from Svene-roe, Norway), and the manganese the same spectrum as that of garnets (zircons from an unknown locality in Siberia).* This method, however, fails to give evidence of a new earth; for, since the publication of my former paper, I have proved that the very abnormal spectra, which seemed sufficient to establish its existence, are really due to compounds of zirconia with the oxides of uranium, which have such a powerful action on light that an almost inappreciable amount is sufficient to produce the spectra to great perfection—in fact, so small an amount that the total quantity which misled me was only a few thousandths of a grain; and its presence might easily have remained unsuspected if I had not made a number of experiments which, at first, did not seem to have much connection with the subject.

In studying the spectra of crystalline blowpipe beads, it seemed desirable to examine those made with carbonate of soda, with or without a little borax. This, when melted, dissolves certain oxides; and, though it crystallises on cooling, so as to be only partially translucent, yet, with strong direct sunlight, well-marked spectra may be seen. For example, in the oxidising flame, uranic oxide is easily dissolved by carbonate of soda alone, and, when quickly cooled, an orange-coloured bead is obtained, probably containing uranate of soda in a vitreous condition, which gives a single well-marked absorption band in the green with so small a quantity of the oxide that, in a bead ¼ inch in diameter, 1-2000th grain shows the spectrum to the best advantage, and even 1-10,000th grain can be easily detected. We need not be surprised that this spectrum differs so much from the usual type of uranic salts, since, in this case, the oxide plays the part of an acid. It may be only an accidental coincidence, but this difference is analogous to what so commonly occurs on adding an alkali to neutral solutions of vegetable colours.† When gently re-heated, it seems as if the uranate passed into a crystalline state, for the spectrum then shows four absorption-bands, and is more like the ordinary type; but this change does not occur if a little borax had been added. The addition of more and more borax causes the absorption-band to become more and more faint, and to advance towards the blue end, until we obtain a spectrum with very faint bands, but of the usual character.

In examining the various products into which I separated jargons in order to study the supposed new earth in a state of purity, I obtained a small quantity of a dark-coloured substance (apparently zirconia) containing some oxide, which communicated a green tint to a glassy borax blowpipe bead, but yet not sufficiently distinct to show that it was due to uranous oxide. I therefore thought that the carbonate of soda method might throw light on the question; and, though the presence of zirconia prevented solution by pure carbonate of soda, the addition of a little borax enabled me to prove that uranic oxide is really present in some jargons. Such, then, being the case, it seemed desirable to ascertain whether the oxides of uranium would give rise to any special spectra when present along with zirconia in crystalline blowpipe beads. To my astonishment, I found that the spectra were precisely the same as those obtained in the case of what I had thought to be an approximately-pure new earth. When, however, I had ascertained the quantity of oxide requisite to give this result, I was no longer surprised that I had not suspected its presence. In the case of transparent blowpipe beads of borax with microcosmic salt, it is requisite to have as much as about 1-50th grain of uranous oxide to show faintly the characteristic absorption-bands; whereas, when present along with zirconia in the crystalline beads, 1-50,000th grain gives an equally well-marked spectrum; and 1-2000th grain shows it far better than a larger quantity, which makes the beads too opaque. These very minute quantites were obtained by the repeated division of a small known weight, either before or after fusion with borax. This spectrum also differs very considerably from the spectra of the usual salts or blowpipe beads of uranous oxide. On comparing them side by side, the only common peculiarity is the fact of there being numerous absorption-bands distributed over a large part of the spectrum, but they do not correspond in either number or position; on the contrary, they differ almost as much as possible; and the darker bands in the spectrum of this zirconia compound occur where the transmitted light is the brightest, in other cases.

The oxide of uranium is so easily reduced at a high temperature to the state of protoxide in a borax bead with excess of boric acid, and is so readily peroxidised at a dull red-heat when crystallised along with borate of zirconia, that there seemed good reason to refer the change in the spectra to temperature rather than to the state of oxidisation, until after it was found that they were due to uranium. By gently flaming the crystalline bead, the spectrum is entirely altered to that which seems to be characteristic of the compound of borate of zirconia with uranic oxide. This shows a spectrum with five well-marked absorption-bands, all of which occur at the red end, where there is no trace of bands in the case of the ordinary compounds of uranic oxide. I have tried many experiments in order to ascertain whether any other element besides zirconia will cause uranium to give similar abnormal spectra; but none show anything of the kind—at all events in similar conditions. A few have special characters, as described below; but the majority exert little or no influence; and, even when the blowpipe beads are crystalline, they show only the usual spectra of the oxides of uranium. Moreover, no such great change in the character of the spectra of any other elements which give absorption-bands is to be seen when they are combined with zirconia; and, as far as my present experience goes, it seems as if such very abnormal spectra were met with only in the case of these remarkable compounds of zirconia with the oxides of uranium.

Such, then, being the facts, it appears to me that we are now in a position to explain why certain zircons give three different spectra, as described in my former paper. Some jargons (usually those of a green tint) contain a little uranium so combined that the characteristic spectrum is only faintly visible; whereas, after ignition, the intensity of the absorption-bands is permanently increased to a variable extent, occasionally only a little, but, in some cases, as much as twenty-five times. This more powerful action on light is accompanied by an increase in hardness and in specific gravity (sometimes as much as from 4·20 to 4·60), as described in my former paper; and I have since found that these changes are approximately proportional to the amount of uranic oxide in the various specimens, as shown by comparing the spectra of the blowpipe beads. This change may partly depend on the oxidisation of the uranous oxide, since some specimens slightly increase in weight when ignited; but I think it cannot be mainly due to that, for sometimes there is no such increase; and uranous oxide, combined with zirconia, gives rise, not to a spectrum without bands, but to one with several of very marked character, as described below. On the whole, since this abnormal type of spectrum is so characteristic of combination with zirconia, it appears to me more probable that the effect of a high temperature is to cause the uranic oxide to combine more specially with the zirconia, as though the greater part existed naturally

* For both of these I am indebted to my kind friend Mr. David Forbes.

† See my paper in *Proc. Roy. Soc.* 1867, vol. xv., p. 433.

as a silicate, but after ignition as a zirconiate. We may also apply the same explanation in the case of zircons more or less strongly coloured by other oxides, which become almost colourless when heated; and thus this unexplained peculiarity of zircons may depend on the fact of zirconia being able to play the part of both a base and an acid, which, as compared with silica, has an affinity for bases varying according to the temperature.

The brown-red zircon from Ceylon (named at page 514 of my former paper, kindly presented to me by Mr. E. L. Mitford, of Rusthall) gives a spectrum precisely like that of the borax blowpipe beads crystallised after treatment in the deoxidising flame, and, therefore, no doubt contains uranous oxide. This spectrum, being given by only one part of the crystal, probably depended upon the presence of some substance which either reduced the uranic oxide or prevented the oxidisation of the uranous.

These facts thus clearly show that the various spectra which seemed to indicate the presence of a new element existing in three different physical conditions are, in reality, only characteristic of the two oxides of uranium, combined with zirconia or not in combination. Perhaps some may think that my having been thus led astray shows that little or no reliance can be placed on the method of investigation employed; but I contend that the mistake was due to its being such an unexpectedly delicate test for uranium; and, as explained above, the error was ultimately corrected by a further development of the same method. As far as the interests of science are concerned, there is no need to regret the general result. We have lost what appeared to be good evidence of a new earth, but have gained an almost entirely new system of blowpipe testing, which enables us to detect such a minute quantity of some substances as could not be recognised by the ordinary means. I shall not now attempt to give anything like a full account of this subject, since it would be much better to let it form part of a paper on various improvements in blowpipe chemistry, but will merely mention a few facts which have a special bearing on the question before us.

In the first place, I would say that zirconia and the oxides of uranium are most useful reagents in detecting the presence of certain substances, with which they unite to form compounds having very special characters. The most striking of these are the compounds already described, which are distinguished by the spectra, and not by any well-marked colour—the compound of ceric oxide with uranic oxide, which is of a splendid deep blue colour, but shows no absorption-bands; and that of yttria with uranic oxide, which is characterised by a deep orange-colour and extreme fusibility. Thorina and oxide of lanthanum form with uranous oxide compounds which give spectra with absorption-bands in special positions, but of the usual type, and not of such a marked character as to be useful in detecting minute quantities of those substances in mixtures.

In order to see the spectra of the zirconium-uranium compounds, it is requisite that their oxides should be combined in a crystalline condition. When both constituents are melted in borax and are held in solution, or if when crystals are deposited any other substance replaces either the zirconia or the oxides of uranium, the characteristic spectra cannot be seen. The most simple application of this test for uranium is in the case of various zircons. As much of the powdered mineral as will dissolve should be melted with borax in a circular loop of platinum wire about ¼ inch in diameter, so as to give a bead of moderate thickness. A little boric acid should then be added, which not only tends to keep the uranium in the state of protoxide, but also facilitates the crystallisation of the borate of zirconia, which is far less soluble when there is excess of boric acid. The bead should then be kept at a bright red heat, just within the deoxidising flame, until so much borax has been volatilised that small needle-shaped crystals begin to be deposited, when it must be allowed to cool rapidly. It should then be transparent with scattered crystals, and the uranium all in the state of protoxide. On gently re-heating it, the bead ought to suddenly turn white and almost opaque; and care must be taken not to heat it any more than is just requisite to cause the borate to crystallise out, or else the uranium will rapidly pass into the state of peroxide. Such beads must be examined by strong direct light from the sun, or from a lamp of very great brilliancy, condensed on them by means of an almost hemispherical lens of about ¼ inch focal length; and in addition to the means described in my former paper, I have since found it very convenient to place them over a hole in a black card, so as to entirely prevent the passage of any light which has not penetrated through them, even when so arranged in the focus of the microscope that the spectrum of their thin edges may be examined, if the centre be two thick and opaque. If thus properly prepared, the presence of more or less uranium will be shown by the greater or less intensity of the absorption-bands of the spectrum described and shown in Fig. 1 of my former paper. This test is so delicate that there is no difficulty in seeing the darker band in the green in the case of zircons which contain no more than 1-10th per cent of uranic oxide; and I find that very few localities yield this mineral so free from it that it cannot be easily detected. Those from Miask, Siberia, are the only specimens in which I have not been able to recognise it. The jargons from Ceylon contain an amount varying up to about 1 per cent, although in no published analysis that I have seen is there any allusion to the presence of even a trace. It has also been overlooked in several other cases; and it now becomes important, because it gives rise to various well-defined spectra, which are so characteristic of the different minerals, that they can be very conveniently identified, even when cut and mounted as jewels, by means of the number and position of the absorption-bands, as I intend to explain in a paper on the spectra of minerals.

In applying this test to detect minute quantities of uranium in other minerals, it is requisite to bear in mind that zirconia may play the part of both an acid and a base, and that various oxides and acids so combine with the zirconia or the oxides of uranium as to prevent the formation of the compounds which give rise to the characteristic spectra. The zirconia appears to combine with some rather than with the uraneous oxide, and with others rather than with the uranic, so that, if one spectrum cannot be obtained, the other may; and there are few, if any, cases when neither can be seen, especially if care be taken to use excess of zirconia. If, however, the amount of uranium be very small, and so much of other oxides be present as to make the bead very dark, or too opaque from deposited crystals, before it is sufficiently concentrated for the compounds with the oxides of uranium to crystallise out, it may be impossible to detect it. In order to apply the test in the case of complex minerals, a bead of borax, boric acid, and pure zirconia should be prepared, then a small quantity of the mineral added, and, after fusion and sufficient concentration, the bead made to crystallise in the manner already described. If needle-shaped crystals be not deposited in the bead when very hot, and if it do not suddenly turn opaque when re-heated, the result may not be satisfactory. In this manner it is easy to detect uranium in 1-200th grain of such minerals as Fergusonite, tyrite, and yttrotantalite, even when they contain no more than 1 or 2 per cent. If, in such cases, the spectrum of the uranous compound cannot be obtained, the bead should always be flamed and re-examined, to see if that of the uranic compound is thereby developed.

In a similar manner, we may make use of a little oxide of uranium to detect zirconia; but the test is far less delicate than the converse, because it is almost impossible to obtain the compound in a crystalline state, unless there be an excess of zirconia. Not more than 1-1000th grain of uranic oxide should be employed, or the bead may be too opaque. There is no difficulty in thus detecting zirconia in zircons, or in katapleiit; but the presence

of so much of other bases in minerals like eudialyte prevents our obtaining a satisfactory result. There certainly could not be a more characteristic test to confirm the results of other methods, or to identify such a small quantity of approximately pure zirconia as could not easily be distinguished in any other way.

The only other compound of uranic oxide of very abnormal character which I have so far discovered is that with ceric oxide. So much of both should be fused with borax in the oxidising flame as will yield a bead which is perfectly clear and of pale yellow colour when rapidly cooled, but crystallises when gently re-heated. If the constituents be present in a certain proportion, it then turns from pale yellow to a deep blue, as though coloured by oxide of cobalt. In most cases, the bead is rendered nearly opaque by the number of crystals; but sometimes, though it turns deep blue, it remains transparent, owing to the compound being set free in a state similar to that of the red oxide of copper in a borax blowpipe bead, with carbonate of soda and oxide of tin, treated in the reducing flame. The spectrum of these blue beads shows no absorption-bands, but merely a general absorption at the red end; and it is curious to find that the combination of two yellow substances gives rise to a deep blue, in much the same manner as when the yellow ferrocyanide of potassium is added to a yellow ferric salt. The production of this blue colour, on the addition of a little uranic oxide, might be employed with advantage to identify moderately small quantities of cerium, even when mixed with a number of other substances; but, unfortunately, the presence of much oxide of lanthanum, which is so commonly associated with it, interferes, as though the ceric oxide had a stronger affinity for the oxide of lanthanum than for uranic oxide.

The most characteristic peculiarity of the compound of yttria and uranic oxide is that it will not crystallise out from a borax blowpipe bead, and that the affinity of the uranic oxide for yttria is stronger than for zirconia. Perhaps erbia may prove to act in the same way, but I have not been able to examine that earth quite free from yttria. On adding yttria to a bead with zirconia and a little uranic oxide, and gently flaming it in the oxidising flame, the uranic oxide combines with the yttria and rises to the surface as an orange-coloured scum, which has a great tendency to collect on the platinum wire; and, if sufficient yttria was added, the crystallised borate of zirconia is left in the interior almost colourless, and so free from uranic oxide that no absorption-bands can be seen in the spectrum. We may take advantage of this circumstance to detect yttria in small quantities of compound minerals like Gadolinite and Fergusonite; and I may here say that, by combining such means with the observation of the spectra of the transparent, or crystalline beads, and of the form of the crystals when slowly deposited, with or without the addition of suitable reagents*, we may often detect twice as many constituents in minerals as could be accomplished by the ordinary methods of blowpipe chemistry—an advantage which I am sure will be appreciated by those engaged in the study of rocks, when it is often so important to obtain satisfactory results with small quantities of material. I have also found these methods of great practical use in examining small residues in the qualitative analysis of minerals, and have thus unexpectedly discovered small quantities of comparatively rare elements.

I have tried the effect of many other substances along with zirconia and the oxides of uranium, and find that most of them have no sensible influence, unless they are present in considerable relative quantity. The most striking effect is that of oxide of tin, which causes the two absorption-bands in the yellow and yellow end of the green in the spectrum of the uranous oxide compound to be nearly equally dark; whereas, without the oxide of tin, that in the yellow is comparatively faint. This is another illustration of the manner in which certain substances having no special action on light influence by their presence the properties of another. The oxides of uranium are unusually sensitive to such actions, and thus not only lend themselves to us as blowpipe reagents, but also seem more than any others to afford the means of explaining the relation between the physical conditions of compounds and their action on light.

The only compound of zirconia with any other oxide to which I need now draw attention is that with chromic oxide, as deposited from a borax blowpipe bead. When treated in the deoxidising flame, and when cold, the very pale green bead gently re-heated, this compound crystallises out so as to give a fine red-pink colour by transmitted light, even when so little chromium is present that the glassy bead is scarcely at all green. If too strongly heated, the pink tint is lost. This compound is of interest in connection with the colour of rubies and other minerals coloured red by chromic oxide. To others, like the emerald, it communicates a green colour, and, on the whole, it acts on light in such a variable manner, according to the presence of other substances, that the spectra may be made use of as a means of identifying particular minerals, though they do not present anything like such striking anomalies as those met with in the compounds of zirconia with the oxides of uranium.

* See my paper, *Monthly Microscopical Journal*, vol. i., p. 349.

ON CHLORAL HYDRATE.

By Dr. MACVICAR, Moffat, N.B.

THE physiological interest which attaches to this substance at the present moment induces me to present it as it presents itself in the system of molecular morphology, since I find that this may be done (though, of course, not very well) by the use of such types as are already in the hands of the printer as representatives of the forms of the elements involved.

As to the laws of chemical union and decomposition which are here referred to, or, indeed, which are ever admitted in the molecular nature which I advocate, they are all included in the law of symmetry, culminating in sphericity, towards which the first step usually is the union of dissimilars, when they come into the same neighbourhood.

It is only necessary to add (since no printer's type in use can show it) that the atom of hydrogen is the simplest structure possible into which equal and similar elements of matter or force can be built up so that it shall be truly symmetrical in relation to the sphere—that is, shall have two poles which are similar to each other, and an equator lying evenly between them. It, therefore, consists of five material units—two for the two poles, and three for the equator (for no smaller number than three can determine a plane). As to its form (that is, the form of the nucleus, for, as to the ethereal atmospheres of all atoms, they are universally spheroidal or spherical), supposing it viewed in reference to the lines of resultant force which join the five constituent forces in the angles, and so give edges to the form, we may say that it is doubly trachar or lance-shaped. The limit of its atomicity is 5. It may possibly carry atoms of some other substance, single or multiple, piled one on each of its two poles and three on its equator, five in all, but no more.

Its symbol, as a chemical agent, may be represented by three dots in a horizontal line, to represent its equatorial atomicity, as, also, other two, one above and another below, to represent its polar atomicity.

Hydrogen: its atomicity = 5.

But, for convenience, we may take to stand for it merely

a printer's dash or dagger, the former of which may represent unity, also its atomic weight on the usual scale.

Hydrogen: its usual symbol.

For oxygen, we may take the figure 8, laid horizontally, and with an uniformly-broad face. Since the atom of oxygen comes out in shape a double concave lens, like a blood-disc or life-buoy, the cypher that has been named has some resemblance to its vertical section through the centre. It is also the atomic weight of a single atom on the usual scale, the law of sphericity requiring that these atoms, when in the free state, shall go in couples,

Oxygen gas.

the atomic weight of each 16 when H = 1.

Moisture.

The atom of carbon comes out a doubly-convex lens, fitting that of oxygen, as in an achromatic arrangement of lenses; it may, therefore, be represented by a narrow letter O. As in the case of oxygen, and for the same reason, single atoms of carbon tend, also, to go in couples;

A coupled atom of carbon.

but it is not possible to use the atomic weight 6 or 12 as its symbol in diagram-formulæ.

Add to these a longer letter of the same kind, to represent chlorine, and we have symbols sufficient for our present purpose.

Chlorine.

Carbon is first given to nature as the hydrocarbon, $HCH=CH_2$, a lengthened form of which every two

Nascent marsh gas.

under the law of sphericity unite in couples, constructing thereby a most exquisitely-spherical and finely-differentiated structure, viz., $\overset{4}{C}HC=C_2H_4$ = marsh gas.

Mature marsh gas.

The genetic atomicity of a coupled atom of carbon is, therefore, 4, in reference to hydrogen; and marsh gas is the perfect hydrocarbon. It is indestructible, if the temperature of its genesis be respected, and is most fit for existing in the aëriform state above.

But nature detains it below, by loading, during vegetation, each of the three hydrogen-arms of the equator with an atom of carbon. And this may be applied to the axial atom in so many different ways that the formula $CH(HC)_3C=C_5H_4$ will represent many substances of different properties. Of this element, the smallest dense

The essential-oil element.

molecule must be the tetratom, giving, as its formula, $4\times(C_5H_4)=C_{20}H_{16}$, which is the chemical formula of non-oxygenated essential oils.

In regions of vegetable nature, where free carbon prevails still more, the retained hydrogen is made to go still farther, and one essential-oil element is made to yield four alkaloid elements—that is, elements in which each single atom of hydrogen is an axis loaded with five of carbon, thus saturating its atomicity.

The alkaloid element.

Unhappily, the load of carbon here is so great that this structure cannot be raised, by the chemist, into the aëriform state and sublimed. It appears to him merely in a carbonaceous residuum containing hydrogen.

But when one atom of hydrogen more is added to either pole, the atoms can ascend in couples and be sublimed, their first dense molecules being the tetratom, giving $4\times(C_5H_2)=C_{20}H_8$, which is the usual formula of naphthaline. Respecting this substance it is impossible to say to what valuable account the ingenious chemist may yet turn it for enhancing the enjoyment of life and for the relief of suffering.

The naphthaline element.

Returning now to marsh gas, with which we set out, it is to be considered that it may be loaded with carbon on the poles, as well as on the equator. Thus, in dry and hot regions, there may be on each pole a coupled, instead of a single atom of carbon, giving $C_2H_4C_2=C_4H_4=$ =olefiant gas.

Olefiant gas.

And in moist and cool regions, there may be an atom of simple hydrate of carbon, CHO—that which we obtain from the breaking up of an atom of sugar, $C_{12}H_{12}O_{12}$ —and which we may call the saccharine element, which is trimorphous.

The saccharine element.

Place one of these saccharine elements—say that in the middle diagram—upon the poles of one atom of marsh gas and we obtain—

$$\overset{4}{H}COC\overset{4}{H}COCH=C_4H_6O_2=\text{Alcohol.}$$

Alcohol.

Its three forms may be represented in our figurate formulæ. The chemical formula of all the three is, of course, the same:—

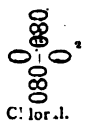
Alcohol $C_4H_6O_2$.

And this, we see, must be a very quick substance, its poles being capable of any one or other of these different structures, according to the conditions of its existence.

Under the law of sphericity, its axis is, however, too long; it is ready to lose something from its poles, and to receive expansion of its equator. Let chlorine, then, be let in upon it, so as not to disorganise it, but to improve its form, and we may expect that two atoms of the halogen will carry off the two atoms of hydrogen from the poles, as hydrochloric acid, thus shortening the axis, which was the first thing required by the law of symmetry (sphericity), and, afterwards carry off the three atoms of hydrogen now constituting the too feeble equatorial region,

and leave three of chlorine in their stead. The atom of alcohol will thus be transformed into—

$$COCHCl_3COC = C_4HCl_3O_2 = \text{chloral.}$$



Chloral.

But this structure is greatly in want both of hydrogen and of oxygen; for the atomicity of a single atom of carbon is 2, in reference to oxygen, as well as hydrogen; and here there are only 2 of oxygen and 1 of hydrogen for 4 of carbon. Since, then, the law of symmetry allows it, we may expect that, on access being granted to moisture, the terminal atoms of carbon on the poles will resume their original condition of saccharines, and we shall have—

$$HOCOCHCl_3COCOH = C_4H_3Cl_3O_4 = \text{chloral hydrate.}$$

Chloral hydrate.

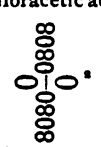
Now, as the poles (the region of chemical activity) here are saccharines, as in alcohol, there seems no reason to apprehend that this substance, so long as it keeps together in the living body, will be more poisonous than alcohol, though it must be more powerful. As to where it will break up when it is obliged to do so, this will depend on the process by which it was made (for every substance, when decomposing, other things being equal, tends to reproduce its original constituents) and on its surroundings. But, viewed in reference to its own structure, it may be regarded as an atom of chloroform, C_2HCl_3,

Chloroform.

capped on both poles by fully-oxidised saccharines—that is, by the formic element, CHO_2, the couple of which gives $C_2H_2O_4$, or $C_2HO_3.HO$ = formic acid.

The formic element.

When chloral hydrate then meets with matter more powerfully alkaline than its own body (which is an atom of chloroform), the polar elements may be expected to go off, thus exposing an atom of chloroform. Suppose they were to go off as saccharines, they would do no harm, nor would the dioxide of chloroform that remained probably be so dangerous, or effective, in causing sleep ("the sister of death") as the chloroform itself. But formic acid, if by any mistake it should get free, might prove a very disorganising agent. But would not all danger from the breaking up of the polar matter be avoided, if, for chloral hydrate, trichloracetic acid could be substituted,



Trichloracetic acid.

for then there would be given off only dioxide of carbon, which is perfectly harmless and might even be useful in assisting the hypnotic action.

ON ORGANIC MATTER IN THE AIR.*

By Dr. R. ANGUS SMITH, F.R.S., &c.

(Concluded from p. 65).

After these opinions and the detail of many facts, one is mentioned which was the culminating point of the enquiry, and has led to a mode of collecting the organic particles of air, which I may call established. This word established is used because the experiment has been done by others. It is given in these few but plain words:—"The air of cow-houses and stables is to be recognised as containing more particles than the air of the street in which my laboratory is, and of the room in which I sit, and that it contains minute bodies, *which sometimes move, if not at first, yet after a time, even if the bottle has not been opened in the interval.* There is found, in reality, a considerable mass of debris, with hairs, or fine fine fibres, which even the eye, or, at least, a good pocket-lens, can detect. After making about two-dozen trials, we have not been able to obtain it otherwise. Even in the quiet office at the laboratory, there seemed some indications."

"I found similar indications in a cow-house, with healthy cows. So I do not pretend to have distinguished the poison of cattle plague in these forms; but it is clear that, where these exist, there may be room for any ferment or fomites of disease; *and I do not doubt that one class is the poison itself in its earliest stage.* It would be interesting to develop it farther."

I do not detail the examination made of the condensed air brought from a cow-house by Mr. Crookes; nor do I detail the examination of the cotton through which Mr. Crookes had passed the air; nor the glycerine surfaces exposed to the air of cow-houses, which, also, was done by Mr. Crookes. My object at present is, not to give a history, but a few of the prominent points, so far as relates solely to my own part.

These experiments were repeated on air in Manchester. A paper was read, on March 30th, 1868, to the Literary and Philosophical Society, Manchester, Dr. Schunck in the chair. To quote a part:—

"Lately, I tried the same plan on a larger scale. A bottle of the capacity of 4·99 c.c. was filled with air, and shaken with water. The bottle was again filled, and shaken with the same water; and this was repeated 500 times, nearly equal to 2½ millions c.c., or 2·495 litres. As this could not be done in a short time, there was considerable variety of weather, but chiefly dry, with a westerly wind. The operation was conducted behind my laboratory, in the neighbourhood of places not very clear, it is true, but from which the wind was blowing to all parts of the town. I did not observe any dust blowing; but, if there were dust, it was such as we may be called on to breathe. The liquid was clouded, and the unaided eye could perceive that particles very light were floating. When examined by a microscope, the scene was varied in a very high degree—there was evidently organic life. I thought it better to carry the whole to Mr. Dancer, and to leave him to do the rest, as my knowledge of microscopic forms is so trifling, compared to his."

Having for years, therefore, convinced myself of these results, I took the air washings to Mr. Dancer, of Manchester, whose experience in microscopic objects is so great that I was certain to be corrected, if I erred; and, if I did not err, I should be taught more. His examination is very beautiful; and it shows, not only organic substances, but very many in quality, and inconceivably many as to quantity. The whole cannot be quoted; but the following will suffice:—

"The water was first examined with a power of 50 diameters only, for the purpose of getting a general knowledge of its contents. Afterwards, magnifying powers varying from 120 to 1,600 diameters were employed.

* Read before the Manchester Literary and Philosophical Society, Jan. 25th, 1870.

"During the first observations, few living organisms were noticed; but, as it afterwards proved, the germs of plant and animal life (probably in a dormant condition) were present.

"1. Fungoid Matter.—Spores, or sporidiæ, appeared in numbers; and, to ascertain as nearly as possible the numerical proportion of these minute bodies in a single drop of the fluid, the contents of the bottle were well shaken; and then one drop was taken up with a pipette; this was spead out, by compression, to a circle ¼ an inch in diameter. A magnifying power was then employed which gave a field of view of an area exactly 1-100th of an inch in diameter; and it was found that more than 100 spores were contained in this space. Consequently, the average number of spores in a single drop would be 250,000.

"On the third day, a number of ciliated zoospores were observed moving freely among the sporidiæ.

"Some of this formed a very interesting object, with a high power; and the greater portion exhibited what is called pitted structure. The larger particles of this had evidently been partially burnt, and quite brown in colour, and were from coniferous plants, showing with great distinctness the broad marginal bands surrounding the pits. Others had reticulations small in diameter. They reminded me of perforated particles so abundant in some kinds of coal.

"Along with these reticulated objects were fragments of vegetation resembling, in structure, hay, and straw, and hay seeds, and some extremely thin and transparent tissue showing no structure.

"A few hairs of leaves of plants and fibres, similar in appearance to flax, were seen; and, as might have been expected in this city, cotton filaments, some white, others coloured, were numerous, red and blue being the predominant colours. A few granules of starch, seen by the aid of the polariscope, and several long elliptical bodies, similar to the pollen of the lily, were noticed. After this dust from the atmosphere had been kept quiet for three or four days, animalculæ made their appearance in considerable numbers, the monads being the most numerous. Amongst these were noticed some comparatively large specimens of *Paramecium aurelia*, in company with some very active *Rotiferæ*; but, after a few days, the animal life rapidly decreased, and in twelve days no animalculæ could be detected.

"For the purpose of obtaining a rough approximation of the number of spores or germs of organic matter contained in the fluid received from Dr. Smith, I measured a quantity by the pipette, and found it contained 150 drops of the size used in each examination. Now, I have previously stated that, in each drop, there were about 250,000 of these spores; and, as there were 150 drops, the sum reaches the startling number of 37½ millions."

After these examples, the first being twenty-four years earlier than the last, I need not add that my certain knowledge is that particles both organic and inorganic are found in air.

Further, that some of the organic particles are organised.

Lime, soda, sulphates, and chlorides have been mentioned in another paper as being found, coal-ash and, of course, carbon, and to some extent the amount measured. In railway-carriages, we even breathe rolled plates of metallic iron which are large enough to be seen by the naked eye.

Some of the most difficult particles to remove are those of coal-smoke; they are oily or tarry, or both. These are instances of organic and not organised particles.

For two years I have been endeavouring to measure with certainty the amount of nitrogen in the organic matter, separating it from the inorganic. Some of the results are in the last "Report of the Proceedings under the Alkali Act," and have been pretty extensively published. Other results are soon to be published.

I have not yet spoken of my work, "On the Air of Mines," where drawings of the particles of solid matter are given (in a long report published by the Mines Commission in 1864), because the air was from exceptional places. Still, similar results are got above ground. In the small tubes containing air from the mines and solids, I was able to detect very distinctly organic matter, and to measure the ammonia.

Still, the best proofs are in the sight of actual forms and the moving objects. In finding these with many accessories, I consider their existence in the air of such places as were tried proved beyond all doubt, also long ago proved. We now require good microscopists to examine the individual forms, and to find if every disease has one peculiar to itself, as Mr. Bailey finds every class of plants has its own peculiar pollen. That is probably the next most prolific field for those who desire something more on the subject.

We must not be panic-stricken because of these forms. Some are hurtful; but it may be that others are required for the maintenance of healthy animal life of the highest order, exactly as in vegetable fermentation. We must purify the air within the limits of natural intention, and be careful that we do not overstep its boundaries.

NOTICES OF BOOKS.

Acetopathy, or the Application of Medical Chemistry to Acute and Chronic Diseases. By Francis Coutts. Edinburgh: Bell and Bradfute; John Menzies and Co. 1870.

The author of this pamphlet makes the following assertion:—"I have diligently studied medical chemistry for the past twenty years, and am happy to be able to announce my discovery of an agent applicable to almost every disease, and which is based on purely chemical principles. That agent is acetic acid."

After a perusal of this quotation, our readers will surely agree with us in thinking that any critical remarks of ours would be superfluous. We need only add that the *proper acid* to use is that tested by the author, the price of which is two shillings per quart bottle, and carriage!

Notes for Students in Chemistry; being a Syllabus of Chemistry and Practical Chemistry. By Albert J. Bernays, Ph.D., F.C.S, Professor of Chemistry and Practical Chemistry at St. Thomas's Hospital, London. Fifth Edition. 1870. Churchill.

We are glad to welcome a new edition of this little book. It has been considerably extended, and, as far as we have examined it, it appears to be remarkably accurate. Every chemist who takes it up will be struck with the vast mass of information which the author has condensed into a few small pages. The book really contains the essence of a bulky manual of chemistry. To students preparing for examination it must be invaluable.

CORRESPONDENCE.

SPECTRUM OF THE BESSEMER FLAME.

To the Editor of the Chemical News.

Sir,—In the last number of the Chemical News there is an inquiry respecting the application of spectrum analysis to the Bessemer process of making steel, to which I am able to give a tolerably definite reply. I have not myself been called upon to use it practically, but have had frequent opportunities for examining the flame and of hearing the results of the great experience in the manufacture of the steel at the works of Sir John Brown and Co., from my friend Mr. W. Bragge, who was the first to

suggest its application, and employed Professor Roscoe to make the necessary observations. Though a well experienced person can determine the time when the blast should cease, from the general colour of the flame, yet I am informed that a direct-vision spectroscope is found to be of great value, and is often employed.

According to my own observations, the flame at first gives a continuous spectrum without bright or dark lines, but in a while the sodium line appears, and afterwards several bright red, green, and other lines. There are also developed dark lines, as if from absorption, which becomes more and more distinct, and then more and more faint; and when the spectrum is just free from these dark lines the blowing should cease. I am informed that there are certain special lines which should be carefully observed, but I am unable to describe them definitely. As far as I have been able to judge, the spectrum method would very much assist a comparatively inexperienced observer, but I am by no means persuaded that it would be sure to give better results than those attainable by experience from the general colour of the flame, as seen by the naked eye; though, even in that case, it might be valuable for particular purposes. On adding the spiegeleisen, dark bands are again seen, so as to give rise to a most remarkable spectrum.—I am, &c.,

H. C. SORBY.

Broomfield, Sheffield.
February 14, 1870.

SPECTRUM OF THE BESSEMER FLAME.

To the Editor of the Chemical News.

SIR,—Your correspondent "A. B." will find reliable information on the application of the spectroscope to this process in Roscoe's "Spectrum Analysis," p. 107. The workmen invariably tell the proper time to stop the blast by a change in the appearance of the flame. Although I have watched the process very many times, I was never able to determine the precise point with any exactitude from the appearance of the flame to the naked eye, but with the spectroscope it is easy to determine the point with the utmost exactitude. The temperature of the flame steadily increases from the commencement of the blow until the blast is stopped. About six or eight minutes after the blast has been turned on, a group of red lines makes its appearance; this group is characteristic of carbon and increases in brightness until the carbon has been all burnt out of the iron, when it suddenly disappears.

It is thus extremely easy by watching this group to determine the exact point at which the blast should be stopped, and when watching the flame with the spectroscope I found that the time during which the blast was continued, under the direction of the manager, often differed, sometimes by as much as eight or ten seconds from the proper time as tested by the spectroscope, and by observing whether the charge had been "underblown" or "overblown," I was able uniformly to predict the quality of the steel. Those engaged in the process say that the spectroscope is useless, that it is of no consequence, that the process requires to be watched by a practised eye, and that they prefer to make steel of various qualities to be afterwards sorted than to make steel always of one quality. The experiments which I carried out on this subject at Crewe gave extremely interesting results, and I have no doubt that valuable information as to the change which takes place might be obtained by a further spectroscopic examination of the flame.—I am, &c.,

W. MARSHALL WATTS.

Manchester Grammar School.

SPECTRUM OF THE BESSEMER FLAME.

To the Editor of the Chemical News.

SIR,—In answer to your correspondent "A. B.," I can assure him that the spectroscope is quite capable of indicating the period of "blowing" in the Bessemer process.

By examining the flame through certain coloured glasses, the changes occurring in it can be more easily determined, however. Two blue glasses with a dark yellow glass between give the best combination, and can be used with safety by the most inexperienced, as its indications are so marked and unmistakeable.

For further information on this subject I refer "A. B." to a paper I read before the chemical section of the Philosophical Society of Glasgow, "On the Examination of the Flame of the Bessemer Converter," which was published in the CHEMICAL NEWS of April 9, 1869, or he can have the paper in the form of a pamphlet by sending me his address,—I am, &c.,

THOMAS ROWAN.

Laboratory, 42, Bath Street, Glasgow.
February 14, 1870.

BROWN'S ACTIVE MOLECULES.

To the Editor of the Chemical News.

SIR,—Will you allow me to suggest that if Professor Jevons examines the interesting phenomena brought by him before the Manchester Microscopical Society, and reported in your last number, on the principle of the surface tension of liquids, he will find the clue he is in search of.—I am, &c.,

C. TOMLINSON.

Highgate, N., Feb. 14, 1870.

TRIVALENT ELEMENTS.

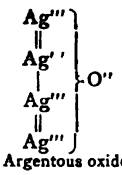
To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xx., p. 293), Mr. J. A. Wanklyn brings forward a new theory of the equivalency of sodium. Sodium has generally been regarded as a monad element, which degree of chemical force it exhibits in most of its salts; but, when we arrive at the so-called double salts (the chloro-platinates and the chloriodides, for instance), this monovalency of sodium is extremely vague.

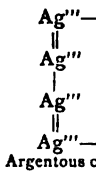
But it must be remembered that shifting the equivalency of one element is a difficult process; for we know that potassium forms salts which are analogous in composition, if not in constitution, with those of sodium. Mr. Wanklyn objects to the hydrate of sodium being written as derived from water, on account of its caustic and extremely active properties; whilst the original type is, in itself, an admirable example of neutrality. Potassium hydrate, being analogous in composition, and possessing the same properties, it is quite rational to expect their constitution should be the same. The simple salts of the two metals can be thoroughly explained by the new theory, as Mr. Wanklyn himself shows in the case of sodium; but there is a point of much more importance than this and that—the explanation of the constitution of the double salts.

Although we have no combination of three monads with sodium or potassium, we have compounds in which sodium unites with an apparently triad element. Thallium, in certain respects, acts as an atom of potassium—it forms a hydrate, chloride, &c. This metal is classed as a triad; and why not sodium and potassium? Triad thallium unites with triad iodine. Triad potassium also unites with iodine.

Thus it may be seen that the alteration of equivalency as proposed by Wanklyn is of unlimited application as regards the now-denominated monad metals. Fownes's "Manual" (p. 360) contains a foot-note, to the effect that, if the formula for argentous oxide (Ag_4O) is correct, oxygen must be a tetrad. And, on the preceding page, chlorine is made to act as a triad, in order that the constitution of argentous chloride may be explained; but, by classing silver as a triad, the difficulty vanishes—



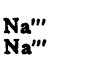
Argentous oxide.



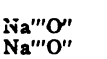
Argentous chloride.

But, to return to the compounds of sodium and potassinm, Wanklyn gives sodium iodide as $INa'''=Na'''I$; but the existence of iodine trichloride is sufficient evidence for the support of the trivalency of that element. If there exist, however, in the molecule *two atoms* of the haloid constituent, we must refer iodine back to the monad list; but, at present, it certainly appears as a combination of two triads—$Na'''I'''$.

Extending the use of this polyvalency of sodium and the analogous metals, we may demonstrate the constitution of the alkaline sulphides, and their subsequent transformation into sulphates under the influence of oxidising agents, sulphur appearing in its highest degree of chemical force—

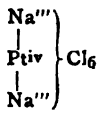


Sodium sulphide.



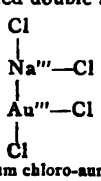
Sodium sulphate.

These formulæ also extend to the potassium and silver salts. But difficulties soon arise; for, by giving to potassium or sodium chloroplatinate the formula—



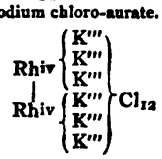
we must ignore the existence of the hydrogen salt, unless we give hydrogen also a triadic signification.

The following formulæ will, perhaps, give an idea of the so-called double salts:—

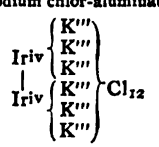


Sodium chloro-aurate.

Sodium chlor-aluminate.



Potassium chlor-rhodiate.



Potassium chlor-iridite.

The above formulæ will show that Wanklyn's views admit of much extension; being in the same isomorphous group as thallium, and acting as that element in all but the thallic salts, sodium, potassium, and silver, although their poly-haloid combinations have not yet been discovered, are with all probability trivalent elements.—I am, &c.,

GEORGE E. DAVIS.

Eton, Feb. 7, 1870.

REACTIONS OF DISULPHIDE OF CARBON WITH BARIC AND CALCIC HYDRATES.

To the Editor of the Chemical News.

SIR,—With reference to a letter on the above subject in your last number from Mr. H. Matthews, I have several times observed a reaction between calcic hydrate and carbonic disulphide, which I have not seen mentioned anywhere, and which you may, perhaps, think worth recording.

Instead of using a solution of lime in this reaction, if milk of lime be employed, and if this be agitated with carbonic disulphide for a short time and then allowed to stand, in the course of twenty-four hours bright orange-red coloured needles will begin to make their appearance in all parts of the sediment. They slowly spread and increase in number and size and in a month or more will have accumulated in considerable quantities.

Not having analysed this product, I am unable to say whether it consists of calcic sulphide or of calcic sulphocarbonate.—I am, &c.,

J. GULSON BURGESS.

Leicester, Feb. 9, 1870.

MISCELLANEOUS.

Chemistry in the House of Commons.—We are glad to find that Mr. U. J. Kay-Shuttleworth has been elected Member of Parliament for Hastings. Mr. Shuttleworth possesses a thorough knowledge of chemistry, and is the author of a valuable text-book for students. He will, we are sure, prove a warm advocate of technical education, and at no time has it been more important to send scientific men to Parliament than the present, when the great question of education is to be brought forward, and, we hope, settled in a manner satisfactory to all classes.

Preparation of Alizarine from Madder.—M. Schützenberger.—Take some yards' length of genuine Turkey red dyed cotton which has been cleansed (*avivé*), cut it up in suitable pieces, best ribbon-like shreds; pour upon it a quantity of strong alcohol (85 per cent strength) well acidified by means of concentrated sulphuric acid; and digest for some days without application of heat; pour off the liquid from the rags and saturate accurately with ammonia (excess is carefully to be avoided), when, by a mixture of ammonia and sulphate of alumina, alumina is thrown down. This is separated by filtration, and the filter washed with some alcohol; the liquid is next concentrated by evaporation on a water-bath, and afterwards water is added, causing a precipitation of mixed fatty and colouring matter; this precipitate is thoroughly dried, and, when dry, exhausted with rectified sulphide of carbon, which dissolves fatty matter, leaving almost perfectly pure alizarine, which, however, if desired, may be sublimed by being placed in a porcelain capsule, and heated on a sand-bath to about 250°. This method yields a pure substance, and, as regards quantity, a very satisfactory result, while the operation is far easier than when either madder or its alcoholic extracts are employed.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, February 6, 1870.

This number opens with a brief communication on a subject which, though not belonging to chemistry, we cannot refrain from quoting, viz.:—

Extraordinary Fall of Snow at Collioure, Pyrénées Orientales, France.—Ch. Naudin.—Collioure is situated on the Mediterranean, in latitude 42° 32' N. The author states that the prevailing temperature, up to the 17th of January, had, as usual, ranged from +11° to +17° C.; it then fell gradually, and on the 21st ult., while at −0·8°, a fall of snow commenced, which continued for 44 consecutive hours. A few of the oldest inhabitants remember a similar phenomenon taking place in the year 1804; very few, however, have ever witnessed such a remarkable occurrence. The average depth of the snow amounted, in open spaces, to from 80 to 120 centims., but in some parts it accumulated to a depth of nearly 1·5 metres (fully 5 ft.); the temperature at this time was about −1°. Among the very noticeable points, the author speaks of the palm trees, which were literally flattened down, as plants are in an herbarium; but, curiously

enough, notwithstanding some of them have been for ten or twelve days in a mass of ice and snow, they have suffered very little, compared with the orange, lemon, and olive trees, most of which are destroyed. The author, therefore, calls particular attention to this fact, because geologists have drawn conclusions as to climate from the discovery of palm trees in the miocene strata; and it appears to him that the facts observed at Collioure prove (though isolated) that these plants might actually stand a severer winter climate than is usually believed, while they also point out that the causes of the death of plants in winter are more complex, and not simply due to a certain degree of cold only.

Proof of the Destruction of the Chemical Type when Substitution Takes Place.—E. J. Maumené.—This lengthy paper is chiefly devoted to prove a peculiar theory which the author holds. The paper is too lengthy for useful abstraction.

On Thermo-Electricity.—J. Delaurier.—The author says—"I have proved the existence of metals and other bodies which are by themselves thermo-electric, and these I call active bodies. The production of electricity is not due to the two metals which are soldered or joined together, since a non-active metal is only a carrier of the electricity developed by heat in the active body. The cause and direction of the current depend chiefly upon the molecular structure of the active body. Heat is converted into electricity by preference in those substances which are relatively better conductors of electricity than of heat. There exist solid bodies which possess the property of yielding as much electricity as hydro-electric elements; among these, tellurium and iron pyrites stand foremost."

Observations on the Zodiacal Light and Aurora Borealis at Munster, Westphalia (Prussia).—M. Heis.

Simplification of the Construction of Holtz's Electrical Machine, and Determination of the Relation between the Dynamical Work Done and the Quantity of Electricity Produced.—E. Bouchotte.—A lengthy memoir on this subject.

Heat Evolved when Silicium Combines with Chlorine and with Oxygen.—L. Troost and P. Hautefeuille.—This paper is a continuation of one on the same subject by the same authors. In this very lengthy memoir, amorphous silicium is treated. The heat disengaged by the combination of 1 grm. of this amorphous body with oxygen is 7830 units; with chlorine, 5630. When 1 grm. of chloride of silicium reacts upon 140 times its weight of water, it is 2915; the heat disengaged when 1 grm of amorphous silicium is converted into crystallised silicium is 290 units of heat. When taken by equivalents, these quantities become, respectively:—

	For Si=14.	For Si=21.
With oxygen	109,620	164,430
With chlorine	78,820	118,230
When the chloride reacts upon 140 times its weight of water	49,820	61,220
When conversion from amorphous to crystallised	4,060	6,090

There is added to this paper a very interesting, but, unfortunately, too lengthy discussion on certain phenomena observed in the Bessemer and other metallurgical processes of iron manufacture.

New Method of Synthesis of Organic Acids.—M. Berthelot.—Reserved for full translation.

Simultaneous Formation of Isomeric Substances in Definite Proportions.—A. Rosenstiehl.—The author refers to his former researches on this subject, and treats, in this memoir, a rather intricate matter, the main gist of which is, that not (as has been stated by several chemists) three, but only two, isomeric toluens are formed when nitric acid acts upon the toluen obtained from coal-tar.

Nature and Origin of the Blood Globules.—MM. A. Béchamp and A. Estor.

Present State of the Volcano of Santorin.—M. Gorceix.

Presentation of Valuable Manuscripts.—M. Bontemps.—This gentleman has handed over to the Academy the very valuable collection of manuscripts left by the late Prof. Charles, whose name is connected with the first experiments of the use of hydrogen, in the year 1783, for the purpose of filling air balloons. The deceased was, in his day, a physicist of celebrity; and his lectures on experimental natural philosophy are well known. The Academy has accepted the offer made by M. Bontemps, who had obtained these papers in consequence of his father having been Prof. Charles's friend and one of the executors of his will.

Journal de Pharmacie et de Chimie, January, 1870.

This number contains the following original papers relating to chemistry:—

Transformation of the Hydrate of Chloral into Chloroform in the Animal Body.—M. Personne.—A physiologico-chemical essay.

Researches on the Electrolysis of Organic Alkalies, or Alkaloids.—M. Bourgoin.—The author, in order to illustrate his subject, begins by explaining the action of an electric current upon perfectly pure and neutral sulphate of ammonia—

$$SO_3NH_4O=\underbrace{(SO_3+O)}_{\text{Positive electrode.}}+\underbrace{(NH_4)}_{\text{Negative electrode.}};$$

and next at the positive electrode, $(SO_3+O)+3HO=SO_3HO+O$, and at the negative electrode, $NH_4=NH_3+H$. The author next describes, at length, a series of experiments made with neutral sulphate of atropine, the acid sulphate of atropine, neutral sulphate of brucine, the acid sulphate of brucine, and the neutral and acid sulphates of codeine and quinine. The conclusions to be drawn from these experiments may be summarised as follows:—The electric current decomposes the salts of alkaloids in the same manner as it acts upon sulphate of ammonia—that is to say, the basic element re-constructs the alkali at the negative electrode, and the rest of the elements of the salt is set free at the positive electrode. When the solution is acid (not readily so when it is neutral), the positive liquid assumes a colouration which is precisely the same as that which nitric acid yields, but is entirely independent of the formation of any nitrated compound. The gas given off at the positive electrode contains not only oxygen, but also carbonic acid and oxide of carbon, often in equal bulks. There are, beside these gases, various other products formed (especially ammoniacal compounds)—the result of the splitting up of the alkalies which are gradually burnt up by the action of the oxygen, which action is the more energetic the more acid the solution contains.

Researches on Bromide of Potassium: its Best Preparation and Composition when Pure.—M. Adrian.—This paper contains the results of analyses of ten samples of bromide of potassium, from which we condense the following points:—The quantity of water interposed (water of decrepitation) between the crystals varied from 4 to 0·5 per cent; the quantity of free, or carbonated alkali, not combined with the haloid, varied from 4 to 1·5 per cent; the quantity of iodide of potassium (contained only in three, out of the ten samples), varied from 2 to 0·5 per cent; the quantity of bromide of potassium varied from 91·60 to 62·80 per cent (average of 10 samples, 83·67 per cent); chloride of potassium varied from 3·5 to 30·07 per cent; sulphate of potassa varied from 0·90 to 3·30 per cent; while, of bromate of potassa, traces were present in all, and an appreciable quantity in one sample.

On Mustard.—M. Commaille.—A lengthy memoir, compiling what is known of the chemical constitution and properties of mustard, and its pharmaceutical uses.

Annalen der Chemie und Pharmacie, January, 1870.

This number contains the following original papers and memoirs:—

On Fermentation, and on the Source of Muscular Force.—Dr. Justus von Liebig.—This paper is the first instalment of a series to be continued. The section title to this memoir is "Alcoholic Fermentation;" we regret that it is not possible here to enter into any details of this memoir, which deserves full translation.

Contribution to our Knowledge of the Bases Contained in Opium.—M. Hesse.—After referring to the labours of M. Merk, and his own former researches on this subject, the author describes meconidine, lanthopine, and laudanine. Meconidine, $C_{21}H_{23}NO_4$, is a rather readily decomposable compound in the presence of strong acids, and especially when heat is simultaneously applied; this base yields salts with difficulty, and these compounds are very unstable. Laudanine is readily soluble in benzol and chloroform, also in boiling alcohol, but difficultly soluble in ether and alcohol when cold; this base, although tasteless by itself, yields, with acids, very bitter salts; fuses at 165°; formula, $C_{20}H_{25}NO_4$; yields salts with acids, well-defined chemical compounds. Lanthopine, $C_{23}H_{23}NO_4$; this substance is best soluble in chloroform, difficultly so in alcohol, ether, and benzol; it yields, with acids, salts. Thebenine, $C_{19}H_{23}ClO_6$ (formula of the hydrochlorate of this base), is an amorphous substance, and rather prone to decomposition.

Treatise on the Urea Compounds.—M. Menschutkin.—First part: The Ureides. Section 1: Action of Cyanate of Potassa upon the Amido Acids, and the Derivatives therefrom.—Oxybenzuramic acid—

$$C_6H_4[NH(CO.H_2N)].CO_2H;$$

oxybenzoyl-urea—

$$C_6H_4[N(CO.H_2N)].CO;$$

oxybenzuramide—

$$C_6H_4[NH(CO.H_2N)].CO.H_2N;$$

anisuramic acid—

$$C_6H_3[NH(CO.H_2N)](CH_3O).CO_2H.$$

Space forbids us to quote more formulæ, with which the treatise abounds.

On Dichlorobromohydrine, and its Decomposition by Hydrate of Baryta.—M. Claus.—The main object of this paper is the vindication of the correctness of the author's labours on the subject, somewhat impugned by other labourers in the same field.

Some of the Combinations of the Toluol Group.—MM. Limpricht and Schwanert.—Second paper on this subject, treating chiefly of:—Oxytolidens, $C_{14}H_{10}O_2$, solid substances, readily soluble in ether and boiling alcohol, fusing at 172°, and subliming without decomposition; bromoxytolidens, $C_{14}H_9BrO_2$, an oily fluid; bibromoxytolidens, $C_{14}H_8Br_2O_2$, a solid substance, soluble in ether, sulphide of carbon, and boiling alcohol; chloroxytolidens, $C_{14}H_9ClO_2$, a solid crystalline body, soluble in ether, benzol, and boiling alcohol, also in glacial acetic acid, and fusing at 57°; trichloroxytolidens, $C_{14}H_7Cl_3O_2$, a solid body, fusing at 87°, and soluble in benzol, ether, hot alcohol, and hot glacial acetic acid; pentachloroxytolidens, $C_{14}H_5Cl_5O_2$, readily soluble in benzol and boiling glacial acetic acid, difficultly soluble in ether and alcohol, and fusing at about 189°.

Preparation of Lepiden from Thionessal.—M. Berlin.—The author heated thionessal with HCl and chlorate of potassa, and the purified product of this reaction was again heated in a sealed tube

with hydriodic acid, to 140°; the resulting product gave, after purifying and re-crystallisation, lepiden, $C_{30}H_{20}O$.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 204, December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

We briefly call attention to two reports, the subjects of which, although not related to chemistry, deserve a passing notice:—

Report on a Printing Stenographic Apparatus Invented by M. Bryois.

Report on the Means of Saving Life in Cases of Fire in Dwelling-Houses and High Buildings.—M. Charrière.—This excellent report is illustrated with woodcuts, and deserves the attention of all whose dwelling-houses and places of abode are at some elevation above the level of the streets.

Alkaline Lakes of California.—M. Phillips.—It appears that a portion of California is very rich in mineral waters, and, moreover, contains large sheets of water, evidently occupying the craters of extinct volcanoes. The water of Lake Owen has a sp. gr. of 1·076, and contains 7128·24 grs. of solid matter to the gallon, consisting of 2942 grs. of chloride of sodium, 956 grs. of sulphate of soda, and 2914 grs. of carbonate of soda; while the rest is composed of sulphate and phosphate of potassa, silica, and traces of organic matter. On the banks of this lake, an incrustration occurs, of yellowish white colour; this substance gave, on analysis, in 100 parts—Chloride of sodium, 2·14; sulphate of soda, 3·10; carbonate of soda, 46·10; silica, 0·22; traces of potassa; and 48·44 of water and organic matter. The Kaysa, or borax lake, yields, daily, 3000 lbs. of crude borax, composed, in 100 parts, of—Dry biborate of soda, 51·85; water of crystallisation, 45·44; insoluble matter, 1·42; dry sulphate of soda, 0·06; chloride of sodium, 0·08; phosphate of soda, 1·15. The water of this lake has a sp. gr. of 1·0274, and contains, of the following substances, the quantities thereby quoted in grains to the imperial gallon:—Chloride of sodium, 1198·66; chloride of potassium, 9·92; iodide of magnesium, 0·22; bromide of magnesium, a trace; carbonate of soda, 578·65; biborate of soda, 281·48; phosphate of alumina, 3·52; sulphate of lime, traces; silica, 2·37; matters volatile at red heat, 238·66. All the salts are calculated in the anhydrous state. The mud of this lake contains large quantities of crystallised borax; at some short distance from this lake, a rich sulphur deposit is met with, which contains, also, a vein of cinnabar; both these minerals are now worked. The quantity of sulphur daily obtained amounts to some 7 tons' weight.

Mining, and some other Industries of Russia.—This empire contains 1043 gold mines, which, in 1866, produced 26·5 tons of pure gold; only 18 tons of silver were produced; the quantity of platinum was 1712 kilos.; and of copper, 4320 tons were obtained. The 262 beet-root sugar works produced, in 1867, 70,000,000 kilos. of sugar; while, during the same period, 382,000 metrical quintals of tobacco were grown.

Official Instruction concerning the Keeping and Use of Nitro-glycerine.—The Chief Inspector of Mines at Dortmundt, Prussia, while sanctioning the use of this material for blasting purposes, has laid down excellent rules for its safe keeping and management, which deserve attention, and may be usefully applied wherever this explosive substance is employed.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 3, 1869.

Among the record of the labours performed at the Chemical Laboratory of this Institution, we meet with a lengthy series of minute analyses of braunkohlen. Kaolin from Budweis—Silica, 48·6; alumina, 43·0; peroxide of iron and magnesia, a trace; water, 8·2. Fire-clay from Biharer (Hungary)—Silica, 60·3; alumina, 28·0; lime, 0·5; water, 10·5. Porcelain clay from Mahrenberg (Styria)—Silicate of alumina, 87·6; alumina soluble in HCl, 5·5; magnesia, 2·1; water, 4·6. Iron ore from the Josephsthal iron ore quarries—Insoluble in HCl, chiefly quartz, 61·8; peroxide of iron, 30·5; lime, 8·0; magnesia, a trace; yield of metallic iron, 21·3 per cent. Crude carbonate of potassa from Czernowitz—Insoluble in water, 0·1; carbonate of potassa, 58·0; carbonate of soda, 2·1; sulphate of potassa, 14·2; chloride of potassium, 3·1; water, 23·2. The Director of this Laboratory, Dr. Karl Ritter von Hauer, states that the water was taken up hygroscopically.

Les Mondes, February 10, 1870.

This number opens with a lengthy paper on the—

Imperial Observatory.—M. Moigno.—The main gist and aim of this paper is a review of M. Le Verrier's career as Director of the Observatory, a situation from which that gentleman has been relieved by a recent imperial decree.

Artificial Construction of Mineral Springs.—M. Rouby.—There is a woodcut annexed to this paper which renders its proper understanding an easy matter. The affair is, however, simple enough, since the contrivance (applicable only in the country, and requiring, moreover, a hilly region) consists of a subterranean water-tight tank, covered on the top with divers layers of minerals, through which the rain-water is made to pass; and this, while trickling down, dissolves a portion of the mineral matters, and enters, thus charged therewith, the tank, from which an exit-pipe leads it to the place of consumption.

Solar Electricity.—M. Marco.

Syphon Pumps and Suction Syphon.—M. Lagillardais.—A good paper on applied hydrodynamics, illustrated by woodcuts.

Improved Photometer for taking Positive Carbon Proofs.—M. Marion.—Illustrated by a cut.

Labour of Children in Manufactories.—Dr. Decaisne.—An interesting account of a large establishment at Lyon.

Annales de Chimie et de Physique, December, 1869.

The only original paper contained in this number is a brief optico-physical description of a—

New Micrometer.—M. Soleil.—Not suitable for abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 10 1870.

Contains nothing relating to chemistry or allied sciences.

February 12, 1870.

Banquet to Dr. A. W. Hofmann at Berlin.—The German Chemical Society, having elected Dr. Rammelsberg as their President for this year, have entertained their late President, Dr. A. W. Hofmann, at a splendid and sumptuous banquet, presided over by Prof. Magnus. Among the large number of guests, we name Dr. R. Virchow, Prof. Dove, Prof. Rose, Dr. du Bois Reymond, His Excellency the Right Hon. Mr. Bancroft, the United States Minister at Berlin, and a very large number of *savants* from Berlin and other parts of Germany. Many of the foreign members sent telegrams of felicitation, and among these the following was received from M. J. Dumas, Paris:—"Your festive meeting is heartily shared by all chemists of the world who admire and cherish you." Just before the meeting broke up, there was distributed a photo-lithograph representing Dr. Hofmann, under the emblem of Jupiter Ammon (typifying his researches on ammonium), with an aureola of aniline colours. A large number of toasts were heartily responded to; and an ode to aniline, composed for the occasion, caused general applause and great merriment.

American Journal of Pharmacy, January, 1870.

Among a great deal of strictly pharmaceutical matter, this number contains the following original papers relating to chemistry:—

Contribution to Our Knowledge of the Chemical Composition of Gelsemium Sempervirens.—Dr. Wormley.—The author made a series of experiments with the fluid extract of gelsemium, and has discovered therein a new organic acid and a new alkaloid—the former having been denominated gelseminic acid, and the latter gelseminine. The preparation and properties of these are described at very great length. In pure state, gelseminic acid is a colourless, odourless, nearly tasteless, solid crystallisable substance, sparingly soluble in water, more soluble in hot water, and freely soluble in ether and chloroform; the substance is a strong acid, completely neutralising bases, and forming salts, which, excepting those of the alkalies, are sparingly soluble in water. The following is a characteristic test for this acid:—When the acid, or any of its salts in solid state, are treated with a drop of strong nitric acid, the substance dissolves under a yellow colouration, to a yellow-reddish, or red solution; if to this be added excess of ammonia, it acquires a deep blood-red colour, which is permanent, at least for some hours. The 1-10,000th of a grain of the solid acid yields, with nitric acid, a well-marked yellow colouration, which assumes with ammonia distinctly a pale red hue. Gelseminine is, in pure state, a colourless, odourless solid, having an intensely bitter taste; it has strongly-basic properties, completely neutralising the most powerful acids; in free state, sparingly soluble in water, freely soluble in ether and chloroform. It is distinguished by the property of yielding, with concentrated sulphuric acid, a reddish brown colour, which, on being moderately heated, acquires a beautiful purple colour; this reaction is produced with even 1-100th of a grain of the alkaloid, or any of its colourless salts. Addition of bichromate of potassa to this acid solution produces no marked change. The alkaloid and the fluid extract are very poisonous substances. This paper contains a toxicological research, in consequence of a case of poisoning having accidentally taken place with the fluid extract of the *Gelsemium sempervirens*, which, we believe, is a native American plant.

Adirondack Mineral Springs.—Dr. Bell.—This spring exists near the Adirondack Mountains, in the state of New York. The water may be regarded as a saline chalybeate, with a considerable quantity of free carbonic acid; it is without smell and any very marked taste. One imperial gallon was found to contain the following substances, expressed in grains:—Sulphate of lime, 11·134; carbonate of lime, 18·543; carbonate of magnesia, 16·618; carbonate of iron, 5·040; carbonate of manganese, a trace; carbonate of potassa, 5·317; carbonate of soda, 5·135; carbonate of lithia, 0·023; chloride of sodium, 14·340; alumina, a trace; insoluble residue, 7·42; free carbonic acid, 67·3 cubic inches.

Naphthaline as a Protective against Moths and other Insects.—M. Markoe.—From the statements made by the author in this paper, it appears that the well and deservedly-known *savant*, Prof. Asa Gray, has thoroughly tested and obtained highly satisfactory results, conclusively proving that naphthaline may be advantageously

used in museums, herbariums, &c., instead of camphor, as a very effective protection against moths and other insects.

The Journal of the Franklin Institute, November, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Oxygen Manufactured on the Large Scale.—Prof. Morton.—The works for this purpose are at New York, and consist of retort-houses, engine-rooms, store-house, pumps for compressing gas in cylinders, and a gas-holder of 26,000 cubic feet capacity. The process is carried on as follows:—About 700 lbs. of manganate of soda are placed in the retort and heated to the requisite degree; superheated steam from a boiler is then admitted for about ten minutes. 2 equivalents of the manganate of soda, and 2 of water, react upon each other, as indicated by the following formula:—

$$2(MnO_3,NaO)+2(HO)=2(NaO,HO)+Mn_2O_3+O_2$$

in other words, the water combines with the soda of the manganate, to form a hydrate of soda, the manganic acid is converted into sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in free state. At the conclusion of this part of the process, the steam is shut off, and the superheated air is admitted for about fifteen minutes whereupon the sesquioxide combines with more oxygen from the air, and is re-converted into manganic acid, which again combines with soda. The retorts in each furnace are charged with 700 lbs. of permanganate of soda, and by the consumption of 2 chaldrons of coke, and with the labour of three men, 25,000 cubic feet of oxygen are made per day. It is now sold at 5 cents (2½d.) per cubic foot, compressed in reservoirs up to a pressure of 250 lbs. to the square inch. The gas is of excellent quality and very pure.

Spectrum of the Aurora Borealis and Zodiacal Light.—M. Angström.

Analysis of Native Phosphate of Lead from Chester County, Pa., U.S.—Mr. Williams.—The author describes, at great length, his method of analysis, and quotes the following results:—(1) Mineral of dark olive-green colour contained, in 100 parts:—Phosphate of lead, 87·40; phosphate of lime ($3CaOPO_5$), 0·37; phosphate of protoxide of iron, 1·74; chloride of lead, 9·79; fluoride of calcium, 0·34; matter insoluble in acid, 0·42. (2) Of a yellowish green shade, in 100 parts:—Phosphate of lead, 85·89: phosphate of lime, 2·64; phosphate of protoxide of iron, 0·62; chloride of lead, 9·41; fluoride of calcium, 0·67; insoluble matter, a trace. (3) Mineral of a darker colour than No. 2, in 100 parts:—Phosphate of lead, 87·01; phosphate of lime, a trace; phosphate of iron, 1·39; chloride of lead, 9·13; fluoride of calcium, 0·91; insoluble, a trace. A separate assay for silver was made, giving 0·0037 per cent, or about 1·1 ozs. to the ton of 2000 lbs.

Native Gold from Venezuela.—Mr. Williams.—It contained, in 100 parts:—Gold, 93·583; silver, 3·687; iron, 1·60; copper, 0·650. No platinum, or metals associated with it, were detected.

Various Processes for Preserving Timber.—Mr. Beer.—This paper is written by the author with the view to contradict and correct several statements made by Dr. Ott in a paper written by the latter on this subject, and published in this periodical.

New Chemical Nomenclature.—Dr. Ott.—This paper, a continuation of a former, contains much valuable information on the history of the nomenclature previous to Lavoisier's time.

The United States' Cabinet of Practical Geology and Mining.—Mr. Wilson.—From this paper, we learn that a cabinet, or collection rather, has been organised at Washington for the collection and preservation of a complete system of geological and mineralogical memorials of the whole extent of the great Republic. M. Roessler, educated at Vienna, and formerly in the Austrian geological service, has charge of this institution.

Electricity Applied to Registering Vibrations.—Mr. Cooley.

Easy Rules for Astronomical Refraction.—Mr. Lyman.

Processes for Preserving Timber.—Dr. Ott.—A continuation of a former paper. This part chiefly treats on what is called Heinemann's process of preservation, by means of forcing molten resin into timber the sap from which has been previously exhausted.

December, 1869.

Separation of Animal from Vegetable Fibre.—Mr. Stuart.—The author subjects rags, carpet cuttings, old carpets, and other waste material consisting of mixed fibres, to a solution consisting of 100 gallons of hot water, 100 lbs. of commercial sulphate of alumina, and 50 lbs. of common salt. In this solution, the material is kept boiling until the vegetable fibre is decomposed; the material is then well washed and dried, and scribbled, or carded.

Electro-Plating with Iron.—Mr. Clay uses a bath composed of ferrous sulphate combined with sulphate of ammonia, potassa, or soda.

Tellurium Ores in the United States.—M. Roessler.—The author states that a mineral named montanite, from the locality where it was found, is a tellurate of bismuth associated with pure telluride of bismuth; another variety contains sulphur in addition (5 per cent), and its formula is $BiS_3+2BiTe_3$. The montanite is a yellowish mineral, with waxy lustre, and contains, according to assay, £20,000 worth of gold to the ton of 2000 lbs. Tellurium minerals are (the author observes) very rarely met with, but, when found, contain generally much gold and silver, which are, however, excluded from native tellurium.

Bayerisches Industrie und Gewerbeblatt, September to December, 1869.

The greater portion of these numbers is occupied by the publication of laws and other official matters relating to Bavaria. Among these, we meet with very complete and well got up instructions for the inspectors of weights and measures, in consequence of the introduction of the decimal system. A large portion of these numbers is devoted to regulations relating to technical instruction, which is carried out to a very high degree in this kingdom.

Application of Heat to Mechanical Labour.—Dr. Linde.—A valuable contribution to the better utilisation of heat to be converted into mechanical force.

Technical Application of Coke obtained from Peat.—Dr. Vogel.

The More Recently Discovered and Valuable Metallic Alloys.—Dr. Fürtenbach.—This very lengthy paper is an excellent compilation on this subject.

NOTES AND QUERIES.

Colours and Pigments.—Can any of your readers inform me of any, or the best, works treating on the manufacture of pigment colours, painters' colours, and paper printers' colours; also, what work is the best on the manufacture of blood and egg albumen.—A READER, Church, near Accrington.

Distilling Tar.—Can you refer me to any work that treats upon the process of distilling tar? I am in a place where I can procure 6 or 7 tons of tar from the gas works every week. There is a tar distiller not far from the town, but he will tell me nothing, even for money. I should like to know the process—how long it is boiled, what vitriol to put in, and how to separate the contents when the pitch is run off. I know that colours are made from it, as well as oil, ammonia, carbolic acid, &c.—A CHEMIST.

Gutta-Percha Vessels for Chemical Uses.—Erroneous views have been held and circulated concerning the durability of gutta-percha under the action of various reagents. We are ordinarily told that it is absolutely unacted upon by cold mineral acids, with the single exception of the sulphuric at 1·6 sp. gr. and upwards. This is far from being the case. There is, indeed, no immediate corrosion, or other rapid and striking change; but, in course of time, the surface becomes overspread with a thin buff-coloured layer, which may be easily rubbed off. This change extends gradually deeper and deeper, till the whole mass loses its coherence and splits in various directions. I have before me a number of jugs which have been used for nitric, chlorhydric, and dilute sulphuric acids, as, also, for solutions of stannous, stannic, and ferric salts, and which, in less than three years' service, have become quite worthless; on being sent for repairs to a dealer in such articles, they were returned with the remark that they "could not be mended, as they had been used for acids." I find that the disintegration in question can be very much retarded if the vessels are always rinsed in cold water immediately after being used.—J. W. SLATER.

MEETINGS FOR THE WEEK.

MONDAY, 21st.—Medical, 8.
—— London Institution, 4.
TUESDAY, 22nd.—Royal Institution, 3. Professor Humphry, "On the Architecture of the Human Body."
—— Institution of Civil Engineers, 8.
—— Ethnological, 8.
WEDNESDAY, 23rd.—Society of Arts, 8. Capt. Douglas Galton, C.B., "On Economy in the Use of Fuel for Domestic Purposes."
—— Geological, 8.
THURSDAY, 24th.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."
—— Royal, 8.30
—— Zoological, 8.30
—— Philosophical Club, 6.
FRIDAY, 25th.—Royal Institution, 8. Capt. Wilson, "Results of Ordnance Survey of Sinai."
—— Quekett Microscopical Club, 8.
SATURDAY, 26th.—Royal Institution, 3. Mr. Max Müller, "On the Science of Religion."

TO CORRESPONDENTS.

*** Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

An Old Subscriber (Maryland, U.S.).—The address of Mr. Siebe, the maker of the refrigerating machine, is Mason Street, Lambeth, London. *Engineering* of Nov. 27th, 1868, gives a description of the apparatus in use at Truman, Hanbury, and Co.'s Brewery.

George Gore, F.R.S., Professor Heaton, Professor Cameron, and H. N. Draper.—Received with thanks.

THE CHEMICAL NEWS.

Vol. XXI. No. 535.

ON THE TESTING OF PETROLEUM SPIRIT.

By F. CRACE CALVERT, F.R.S., F.C.S.

I have read with much interest of late several papers on the Petroleum Act of 1868, and on the uncertainty of getting good results when testing the "flashing-point" of petroleum spirit, especially the papers published by Mr. Paul in the Chemical News and a pamphlet by Mr. Norman Tate, Liverpool, I therefore deemed it my duty to make a series of experiments, with the hope of throwing some light on the subject; the more so that the defect of the Act of 1868 is that no length of time is specified for raising the petroleum spirit from natural temperatures to its flashing-point. Thus the Act states:—

"The outer vessel shall be filled with cold or nearly cold water. A small flame shall be applied at the bottom of the outer vessel; and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one-and-a-half inches beneath the surface."

What is understood by a "*small flame?*" appears to me a difficult question. Shall it be so that it will require fifteen, twenty, or thirty minutes to raise the petroleum spirit from natural temperatures to its flashing-point (say 98° or 105° F.)? The Act does not state.

The following experiments made with six samples of petroleum spirit, placed in my hands by the magistrates of Manchester, will show how important the above question is with reference to the testing of petroleum spirit, and the absolute necessity, for the safety of the public as well as for the interests of those who deal in the article, that the Act should define the exact space of time that should be employed in the testing of any sample of petroleum spirit:—

Sample of petroleum spirit at 52° F.	Time. 15 minutes.	Time. 20 minutes.	Time. 30 minutes.
No. 1. ..	96° F. ..	98° F. ..	102° F.
„ 2. ..	92° „ ..	99° „ ..	101° „
„ 3. ..	90° „ ..	98° „ ..	101° „
„ 4. ..	94° „ ..	96° „ ..	104° „
„ 5. ..	96° „ ..	98° „ ..	110° „
„ 6. ..	95° „ ..	99° „ ..	108° „

These results clearly show the influence of time in raising six samples of petroleum from 52° F. to their flashing-points. Thus, when fifteen or twenty minutes are employed, the whole six samples tested could not be called "petroleum," according to the Act of 1868, and the owner would be liable to a penalty, and to the loss of the fluids; whilst, if the time employed to heat the liquid is half-an-hour, they would all be considered petroleums, their flashing-points being above 100° F.

Therefore, there can be no doubt that, according to the time employed, so are the results altered; the longer an operator is in completing his test, the higher will be the flashing-point of the spirit. This fact is probably due that the most volatile products gradually escape in the atmosphere, and are never in sufficient quantity to produce a "*flash*" when a taper, as described in the Act, is passed within a quarter-of-an-inch from the surface of the spirit. I am, therefore, of opinion that, as the Act has been made to protect the public against fire, or explosions resulting from the employment of too highly inflammable hydrocarbons, the chemist or person called upon to test liquids of this class should raise the temperature of the fluids under examination as quickly as possible (of course, employing the apparatus described in the Act), otherwise, they favour the vendor and manufacturer, to the detriment of the consumers.

The next series of experiments were made with a view of corroborating a statement made by Mr. Norman Tate, Liverpool, viz., if two thermometers are placed into the petroleum spirit, one, as indicated in the Act, 1½ inches below the surface of the liquid, the other thermometer only ½ an inch, a difference of several degrees will be noticed between them at the time the vapours will flash; and I am happy to say that the following results confirm Mr. Tate's interesting observations.

	1½ inches. Flashed at	½ an inch. Flashed at
No. 4.	94° F.	99° F.
„ 5.	94° „	98° „
„ 6.	95° „	99° „

This curious and unusual fact of a fluid having a much higher temperature near the surface than it has an inch below what may be considered as the centre of the bulk of the fluid is due, in my opinion, that petroleum, not being a homogeneous liquid, but a mixture of several hydrocarbons, the highest products being first expelled, the heat rises towards the surface, and in this way produces the difference of temperature referred to. It was with a view of overcoming this practical difficulty that a series of experiments were instituted, in which the operations were conducted in the usual way, with this exception, that the liquid was kept in a constant state of agitation (except at the time when the flame was passed over to observe the flashing-point) by the thermometer; and the results obtained were as follows:—

No. 1 did not flash at 102° F.		
„ 2 flashed at ..	99° F.	Fourteen minutes.
„ 3 „ „ ..	98° F.	„
„ 4	—	
„ 5 flashed at ..	98° F.	
„ 6 „ „ ..	104° F.	

These experiments appear to me to confirm the explanation above given on the cause which produced the difference of the two thermometers placed at unequal depths in the fluids under examination, for it will be observed that the flashing-points of the hydrocarbons are raised several degrees. In my opinion, this fact is due that agitation having facilitated the gradual escape of the most volatile products, the flash will not occur until a sufficient quantity of the more dense vapours have been volatilised and collected on the surface of the fluid to be tested.

I believe that many of the anomalies above described are principally owing to the difficulty—notwithstanding any amount of care that may be bestowed on the operation—to raise the temperature of the petroleum spirit from natural temperatures in a certain time (say fifteen, twenty, or thirty minutes) to their flashing-points. As the true flashing-points of the fluids depend entirely on the time employed in raising its temperature, I would propose the following method, which will enable every operator, in any part of the United Kingdom, to determine the flashing-point of a petroleum with certainty, and feel satisfied that another manipulator would obtain similar results.

The process consists in heating water to 10° above the flashing-point of the spirit (approximately tested) in the outer vessel (such as described in the Act), removing the flame, and then placing the can in the water, filling it at once carefully with the petroleum spirit. The thermometer should then be placed with the bulb ½ an inch below the surface of the spirit, and the flashing-point then ascertained in the usual manner. The following are the results I obtained with the same six samples of petroleum which I employed in my previous experiments:—

	First experiment.	Second experiment.
No. 1 flashed at	98·0° F.	99° F.
„ 2 „ „	95·0° „	96° „
„ 3 „ „	96·0° „	97° „
„ 4 „ „	96·0° „	97° „
„ 5 „ „	96·5° „	97° „
„ 6 „	—	—

I am also of opinion that a gas-flame should be employed, in preference to a spirit-lamp, when the test is made in a similar manner to the directions given in the Act, as greater regularity in the rise of temperature can be secured. I have also used in my experiments (and I advise everyone to do so) the excellent suggestion made by Mr. Norman Tate—viz., a small gas-flame, instead of that produced by a match or taper, for testing the flashing-point of the spirit.

I consider the apparatus proposed by Mr. Miles would tend to give certainty to the assay, which, at the present time, cannot be satisfactorily performed. The above experiments prove that the Petroleum Act of 1868 does not give sufficient and precise instructions for the testing of petroleum spirit. Therefore it is to be hoped that Government will again take the matter in hand, and do away with the objections of the present Act, substituting more clearly defined rules and instructions, to enable the operator to determine the flashing points of petroleum spirit with greater accuracy.

ON A

NEW STEP IN THE PROXIMATE ANALYSIS OF SACCHARINE MATTERS.*

By JAMES APJOHN, M.D.,
Professor of Chemistry and Mineralogy in the University of Dublin.

THE proximate analysis of crude sugars and syrups is a problem of practical importance, and also one of considerable difficulty, as such generally include not only cane sugar, but, in addition, two other varieties of saccharine matter—viz., inverted sugar, and crystallised glucose, commonly called grape sugar. The amount, indeed, of the cane sugar admits, as is well known, of being readily determined by an optical method, in which we may employ Soleil's saccharometer, the previous saccharometer of Biot, or the much more sensitive instrument for which the scientific world is indebted to Professor Jellett. By taking, with one or the other of these instruments, the rotative power on plane polarised light of the saccharine material under consideration, both before and after it has been inverted by digestion with an acid, we obtain data from which, and certain constants, the required information may be deduced. If, for example, separate solutions of the three sugars already named be made, containing 416 grs. in 10 cubic inches, the rotative powers of a column of each 20 centimetres (7·87 inches) long, when measured on the French instrument (with the use of which I am most familiar) are known to be—

For cane sugar	100°
„ inverted sugar..	36° at 59°
„ grape sugar	76°

The rotative powers, therefore, of a single grain of each sugar made into syrup having the bulk already mentioned, and observed in the same tube, will be—

Cane sugar	0·240
Inverted sugar	0·086
Grape sugar	0·182

Hence, the observed rotation before inversion being θ, and after inversion θ', and x, representing the quantity of cane sugar, y, of inverted sugar, z, of grape sugar, we arrive at the two following equations, in which it will be noted that the rotation produced by the inverted sugar has a negative sign, and that the coefficient of inversion of the cane sugar is 0·36 (Jellett) at 59° F.

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (1)$$

$$-x \times 0{\cdot}24 \times 0{\cdot}36 = y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta' \qquad (2)$$

And subtracting the second of these equations from the first, we get—

$$x \times 0{\cdot}24 + x \times 0{\cdot}086 = \theta - \theta'$$

$$x = \frac{\theta - \theta'}{0{\cdot}326} \qquad (2)$$

Very important information is thus rapidly obtained, for the most valuable constituent of any crude saccharine substance is the cane sugar which it includes. But the analysis is imperfect, for we do not learn from it the quantity of either of the two other sugars, nor even their aggregate amount, for this cannot be got by subtracting the cane sugar already determined from 416 grs., as much of the difference is water, and in many cases *its* estimation cannot be accurately effected by any process of drying.

And here it may be observed, that by chemistry alone, and without any assistance from optical science, we can advance a step further than the saccharometer conducts us. We can, for example, reduce Barreswill's solution of copper with a syrup, both before and after inversion. The latter experiment gives us the entire of the three sugars; the former, the sum of two of them, the inverted and grape sugar, while the difference of the results of the two experiments will correspond to the cane sugar. The chemical then goes a little beyond the optical method, for it not only tells us how much cane sugar is present, but, in addition, informs us of the exact aggregate amount of the two other sugars. Further than this it does not go; and we are still unable to assign the exact quantities of inverted and of cane sugar which may be present.

I have now to mention that, in conversing with Professor Jellett on this subject, he threw out the observation that, by combining the chemical and optical methods of experiment, the difficulty just alluded to might possibly be overcome, and the analysis rendered complete. Attaching much importance to his opinion on such a question, I turned the matter carefully in my mind, and soon found that his suggestion was quite correct, as will appear from the following explanation:—

By the optical method already adverted to, and with which physicists are long familiar, we obtain the quantity of the cane sugar; and by *inverting* the syrup, and applying it to the Barreswill's solution, we can get the entire amount of the three sugars, each being estimated on the hypothesis (we shall say) of its being grape sugar. The equations derivable from these two experiments are—

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (a)$$

$$x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \qquad (b)$$

the first being the equation, already explained, which gives the rotative power of the syrup; the second, that which expresses the amount, w, of the three sugars, which, after *inversion*, has been estimated by the *blue solution*. The numerical coefficients in the former equation are, as previously stated, the unit *rotation* powers of the respective sugars, while, in the latter, 1·16 is the ratio of the half atomic weight of cane sugar to that of the atom of grape sugar; and 1·1 is the ratio of the atomic weight of *inverted* to that of grape sugar. Now, as by the optical experiment the amount of the cane sugar, x, has been determined, the first term in each of the equations is known, so that, as there are now only two unknown quantities, y and z, the value of each may be determined.

I have applied this method, on several occasions, in the proximate analysis of crude sugars and syrups, and with satisfactory results. The details of a single experiment recently made will be sufficient here. In operating on the variety of molasses called *golden syrup*, its *rotative*

* From the *Transactions of the Royal Irish Academy*, vol. xxiv.—Science. Read December 13th, 1869.

powers, as given by Soleil's instrument, were found to be as follows:—

Before inversion	38·35°
After inversion..	−12·15

Results from which we find, by equation (3) already given, the quantity of cane sugar in 416 parts of the syrup to be 154·95 grs. The second, or chemical experiment, was then made, which consisted in *inverting* 34·3 grs. of same syrup, and operating upon it with Barreswill's solution, which showed that the 34·3 grs. included 24·75 grs. of saccharine matter estimated as grape sugar, corresponding to 297·26 grs. from 416 of the syrup. Replacing, then, x, in equations (a) and (b) by its value, 154·9, and substituting in them 38·35 for θ, and 154·9 for w, they become—

$$154{\cdot}9 \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = 38{\cdot}35 \quad (a)$$

$$154{\cdot}9 \times 1{\cdot}16 + y \times 1{\cdot}1 + z = 297{\cdot}26 \quad (b)$$

These equations involve only two unknown quantities, and therefore admit of solution, and when worked out we find—

$$y = 70{\cdot}66$$
$$z = 39{\cdot}89$$

so that the final numbers at which we arrive are the following, the figures in column (1) referring to 416 grs. of the syrup, and those in column (2) being percentages.

	(1)	(2)
Cane sugar	154·95	37·17
Inverted sugar	70·63	16·95
Grape sugar	39·87	9·57
Water and other inactive matters..	150·55	36·31
	416·00	100·00

The 36·31 parts set down as water are got by difference. I may, however, observe, that by the direct process of drying *in vacuo* over oil of vitriol only 22 per cent could be obtained, so that it is possible that some gummy matter may be present. Its amount cannot exceed 14·31 per cent, and it is probably much less, as the perfect expulsion of moisture from syrup is, as already observed, a thing very difficult of accomplishment.

I must not close this short paper without stating that the optical observation which gives θ' is one which it is difficult to make with the necessary degree of precision, for, though the syrup may be clarified by animal charcoal, in the process of inversion it invariably acquires a greater or less degree of colour. Fortunately, however, it is not necessary to make any optical experiment on the inverted syrup, for the object of such experiment is to enable us to calculate the amount of the cane sugar, and this can be done in a different way. It is, in fact, quite sufficient, as already explained, to apply Barreswill's solution, not only after inversion, but before it; and the difference of the two results will correspond to the cane sugar present in the syrup. The equations which express the results of these two experiments are the following:—

$$\text{Before inversion, } y \times 1{\cdot}1 + z = w', \quad (m)$$

w' being the grape sugar corresponding to y and z.

$$\text{After inversion, } -x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \quad (n)$$

w being grape sugar, corresponding to x, to y, and to z. From which we deduce—

$$x = \frac{w - w'}{1{\cdot}16}.$$

In working upon this plan with 100 grs. of the specimen of molasses already mentioned, the following results were obtained:—

$$w' = 30{\cdot}64. \qquad w = 72{\cdot}87.$$

From which *data* we find—

$$x = \frac{72{\cdot}87 - 30{\cdot}64}{1{\cdot}16} = 36{\cdot}44,$$

a number approximating closely to 37·17, the percentage of cane sugar as determined by the saccharometer.

From equation (m), too, we learn that the inverted sugar multiplied by 1·1, with the addition of the grape sugar, amounts to 30·64 grs. But by the conjoint aid of the saccharometer and the blue solution, it has been already shown that $y = 16{\cdot}95$, and that $z = 9{\cdot}57$, so that $y \times 1{\cdot}1 + z = 28{\cdot}21$.

There is manifested here, it must be admitted, an appreciable amount of divergence; for, instead of the chemical and optico-chemical methods of assay being in harmony with each other, we find that a result given by the former exceeds the corresponding one given by the latter by 2·43 per cent. The cause of this discrepancy it is not difficult to assign. It must obviously proceed from the presence in the molasses of some principle or principles different from either cane, inverted, or grape sugar, and which themselves exercise circular polarisation, and, mayhap, also exert a reducing action on Barreswill's blue solution. The substances of this nature, which may possibly be associated with the sugars in saccharine juices, are dextrin, asparagin, and tartaric acids; and when any such do exist in a saccharine product, its *exact* proximate analysis is rendered extremely difficult, if not impracticable. It is, therefore, scarcely necessary for me to state here that the optico-chemical process explained by me in this paper, will only give perfectly accurate results when applied to a mixture of cane, inverted, and grape sugars, in which no other *active* principle is contained. I may, however, add that the sugars just enumerated constitute the great bulk of all known saccharine products, and that, when other matters are present which complicate the problem, they are usually in such minute quantity as not to interfere materially with the success of my method when applied generally to the proximate analysis of saccharine products.

ON THE

ALLEGED SOLUBILITY OF GLYCERINE IN CHLOROFORM.

By HARRY NAPIER DRAPER, F.C.S.

IN Watts's "Dictionary" (vol. ii., p. 887), it is stated that "glycerine dissolves in all proportions in chloroform;" and, at p. 889, a process is actually quoted for the detection and estimation of cane-sugar and glucose in glycerine, based upon the assumption of this solubility. The same method (apparently quoted from the same source) is also given in the CHEMICAL NEWS (vol. viii., p. 227).

It is not easy to conceive how Palm, who is the authority quoted by Watts for the analytical method, can have been misled by the somewhat easy *miscibility* of glycerine with chloroform to suppose that it was soluble in that body.

The following experiments were made with Price's glycerine, which had been kept for an hour at 136° C., and was then allowed to cool out of contact with the air.

(a). Equal volumes of glycerine and chloroform were shaken together in a graduated tube, and then allowed to rest. The two fluids completely separated, and their relative volumes were found to be unaltered.

(b). Ten c.c. of glycerine and 100 c.c. of chloroform were violently agitated together, and the mixture poured upon a filter moistened with chloroform. The liquid which passed through was then evaporated upon a water-bath. It left no residue.

(c). Experiment (b), repeated with boiling chloroform, gave an equally negative result.

I deduce from these experiments the conclusion that glycerine is absolutely insoluble in chloroform; and that, on the other hand, glycerine does not dissolve chloroform; and, as the chemical properties of all glycerines hitherto examined are alike, the statement in "Watts" must be considered incorrect, and the process of Palm as having no value.

Dublin, Feb. 15th, 1870.

ACTION OF CHLOROSULPHIDE OF PHOSPHORUS UPON ALCOHOL.

By M. CHEVRIER.

THE only enquiries relative to this subject were made by M. Cloëz, who, in 1847, prepared sulphoxyphosphovinic acid and several of its salts, and, ten years later, examined the action of $PSCl_3$ upon soda-alcohol, and obtained ethylsulphoxyphosphoric ether. His two notices are very short. The first contains no details of the secondary products of the reaction, which, moreover, is not formularised.

This subject has been my study, which was also extended to amylic alcohol.

The action of chlorosulphide of phosphorus upon alcohols is sufficiently complex; nevertheless, with care, it may be easily regulated, and the same products always obtained in the same proportions. (The only alcohols here alluded to are monatomic alcohols, corresponding with the fatty acids). With the first terms of the series (methylic and ethylic alcohols), the action is very lively; but it is less so in the case of more distant terms—such as amylic alcohol. In all cases, the result is a compound acid—the chloride of the alcoholic radical, with evolution of chlorhydric acid, which may be easily collected, so as to allow of the reaction being formularised.

In the case of ordinary alcohol, the reaction is produced between 1 equiv. of chlorosulphide and 3 of alcohol.

$$PSCl_3+3\left(\begin{matrix}C_2H_5\\H\end{matrix}\right\}\Theta\Big)=\left.\begin{matrix}(PS)'''\\C_2H_5\\H_2\end{matrix}\right\}\Theta_3+2C_2H_5Cl+HCl.$$

By means of a special arrangement of the apparatus, all the chlorhydric acid and almost all the chloride of ethyl may be collected. The phenomenon is at all times more complex than the preceding equation would indicate; a small quantity of sulphur is precipitated, and a corresponding amount of ethylphosphoric acid is formed.

Ethylsulphoxyphosphoric acid is an oily liquid, heavier than water, which will not dissolve it, and having a nauseous odour. It is decomposed by dry distillation.

Soda-alcohol. The chlorosulphide, $PSCl_3$, reacts vigorously on soda-alcohol, and yields the corresponding ether discovered by M. Cloëz. All the chlorine of the $PSCl_3$ is fixed upon the sodium in the alcohol. The formula of the reaction is—

$$PSCl_3+3\left(\begin{matrix}C_2H_5\\Na\end{matrix}\right\}\Theta\Big)=3NaCl+\left.\begin{matrix}(PS)'''\\3(C_2H_5)\end{matrix}\right\}O_3.$$

Ethylsulphoxyphosphoric ether is a colourless, oily liquid, insoluble in water, with an odour of rotten beetroot quite as disgusting as that of the corresponding acid. It can only be distilled in a current of steam.

Amylic alcohol. This may be slowly attacked at the ordinary temperature by chlorosulphide of phosphorus. The reaction is facilitated by stirring the mixture, to lessen the viscosity, and heating it in a water-bath. Abundant evolution of chlorhydric acid ensues, with formation of chloride of amyl and amylsulphoxyphosphoric acid. These two liquids are separated by heating the mixture to 105°. The residue is re-dissolved in alcohol, to separate the small quantity of sulphur, and then heated to 100°. The liquid thus obtained is oily, lighter than water (in which it is insoluble), and soluble in alcohol. It is decomposable by dry distillation at about 145°, but is easily distilled in a current of steam. One of its salts was prepared.

Alkaline amylsulphoxyphosphates and the baryta salt are very soluble in water. They are greasy to the touch, like all salts which contain the radical, C_5H_{11}, of amylic alcohol. The formula of the soda salt is—

$$\left.\begin{matrix}(PS)'''\\C_5H_{11}\\Na_2\end{matrix}\right\}\Theta_3$$

That of baryta corresponds to—

$$\left.\begin{matrix}(PS)'''\\C_5H_{11}\\Ba_2\end{matrix}\right\}O_3+Aq.$$

The copper salt is of a greenish-blue colour. It may be used to prepare amylsulphoxyphosphoric acid, by treating it with a current of sulphuretted hydrogen. The crystals of amylsulphoxyphosphates produce very easily the phenomenon of epipolism. When thrown into perfectly pure water, they turn about like camphor until completely dissolved; the least trace of fatty matter will, however, stop the gyratory movement. Epipolic power was ascertained to be present in sundry crystals containing the radical amyl, particularly the sulphamylate of baryta: crystals of phenic acid are similar in this respect.

Amylate of Soda.—The action of $PSCl_3$ on amylate of soda is very energetic. The sodium alcohol is placed in a retort or spherical receiver, and the liquid added to it, drop by drop. The products of the reaction are then treated with water, which dissolves the chloride of sodium formed, and separates an oily liquid, which collects on the surface: this is amylsulphoxyphosphoric ether, a colourless liquid, which in time becomes slightly greenish. It distils in a current of steam, without decomposition. Its density at 12° is equal to 0·849. Its degree of refraction corresponding to the yellow ray of sodium is equal to 1·42. Reaction occurs between 1 equiv. of chlorosulphide and 3 of amylate of soda, as with common alcohol.

$$\left.\begin{matrix}(PS)'''\\Cl_3\end{matrix}\right\}+3\left(\begin{matrix}C_5H_{11}\\Na\end{matrix}\right\}\Theta\Big)=\left.\begin{matrix}(PS)'''\\(C_5H_{11})_3\end{matrix}\right\}\Theta_3+3NaCl.$$

In the case of monoatomic alcohols represented by the general formula—

$$\left.\begin{matrix}CnH_{2n+1}\\H\end{matrix}\right\}\Theta$$

the chlorosulphide of phosphorus gives the corresponding combined acid—

$$\left.\begin{matrix}(PS)'''\\CnHn+1\\H_2\end{matrix}\right\}\Theta$$

the chloride of the alcoholic radical $CnHn+1Cl$ and of chlorhydric acid. Whilst reacting upon the metallic derivatives of these alcohols—

$$\left.\begin{matrix}CnH_{2n+1}\\M\end{matrix}\right\}\Theta,$$

the chlorosulphide $PSCl_3$ produces an ether analogous to the fatty bodies, represented generally by—

$$\left.\begin{matrix}(PS)'''\\3(CnH_{2n+1})\end{matrix}\right\}\Theta.$$

If the kind of decomposition to which chlorosulphide of phosphorus is subject in the presence of those simple or compound bodies upon which its action is exercised be carefully examined, it will be seen that its action is at the same time chlorising and sulphurising. The triatomic radical (PS)''' has a remarkable tendency to substitution in compounds.

All oxygenated compounds which yield the oxychloride $P\Theta Cl_3$ form corresponding sulphuretted compounds furnished by chlorosulphide, $PSCl_3$. This liquid constitutes an excellent reagent for the substitution of sulphur for oxygen.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 63).

IN the following lessons, the possession of an instrument fitted with Mr. Wenham's stereoscopic binocular arrangement has been supposed. As

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869. This and the following articles contain such portions of the demonstrations after the lectures as could not conveniently be incorporated with the preceding text. Much new matter has also been added.

microscopes of moderate price are now so constructed, the author has no hesitation in arranging the following simple course of exercises more especially for its use; nearly all the observations can, however, be made with the monocular instrument.

The following tables, containing lists of the objectives made by the three principal London opticians, with their approximate magnifying powers and angles of aperture, may assist the student in selecting a glass suitable for the object to be examined. It must be borne in mind that the powers given are those of the lenses when used upon the stands of their respective makers; the length of the body materially influences the power of the combination, as will be seen by the table for the use of the draw-tube given in Messrs. Beck's list:—

The screws cut upon the nozzles of microscopes, and upon object-glasses, are now common among English opticians, so that the objectives may be attached to any stand at pleasure.

The following symbols will be employed to indicate the apparatus to be used.

Object-Glasses—

4 in. or 3 in.	O3
2 ,, 1½ ,, ...	O2
1 ,, ⅔ ,, ...	O1
⅔ ,, 4/10 ,, ...	O⅔
⅓ ,, ⅓ ,, ...	O⅓

Higher powers, $O_{\frac{1}{n}}$ with the fraction indicating the nominal focal length.

Eye-Pieces.—When no symbol is used, the lowest power, viz., No. 1, or A, is supposed; medium power,

R. and J. BECK.

Focal Length.		Linear Magnifying Power (nearly) with Eye-Pieces. 1	2	3	4	5	Angle of Aperture about
3 inches	Draw-tube closed	12	20	40	48	74	12 degs.
	Do. if drawn out, add for each inch	2	4	6	7	10	
2 ,,	Draw-tube closed	20	38	70	85	130	18 ,,
	Do. if drawn out, add for each inch	4	6	8	12	15	
1½ ,,	Draw-tube closed	30	56	100	120	190	23 ,,
	Do. if drawn out, add for each inch	5	7	12	15	22	
⅔ ,,	Draw-tube closed	70	120	220	270	410	32 ,,
	Do. if drawn out, add for each inch	8	14	25	27	48	
4/10 ,,	Draw-tube closed	120	210	370	460	710	55 ,,
	Do. if drawn out, add for each inch	14	24	34	46	70	
4/10 ,,	Draw-tube closed	146	255	460	560	890	90 ,,
	Do. if drawn out, add for each inch	18	32	48	60	80	
⅓ ,,	Draw-tube closed	200	340	590	720	1120	75 ,,
	Do. if drawn out, add for each inch	24	42	63	85	120	
⅕ ,,	Draw-tube closed	225	400	700	860	1450	85 ,,
	Do. if drawn out, add for each inch	18	35	60	80	130	
⅕ ,,	Draw-tube closed	225	400	700	860	1450	100 ,,
	Do. if drawn out, add for each inch	18	35	60	80	130	
⅛ ,,	Draw-tube closed	500	870	1500	1850	2800	120 ,,
	Do. if drawn out, add for each inch	60	100	180	190	370	
1/10 ,,	Draw-tube closed	900	1570	2750	3450	4950	140 ,,
	Do. if drawn out, add for each inch	80	150	300	350	900	

THOMAS ROSS.

Object Glasses.	Angular Aperture.	Magnifying Powers with the various Eye-Pieces. A	B	C	D	E	F
5 inches	7 degs.	8	13	24	36	52	72
4 ,,	9 ,,	10	16	30	45	65	90
3 ,,	12 ,,	13	20	35	56	84	112
2 ,,	15 ,,	20	32	55	90	135	180
1½ ,,	20 ,,	25	40	70	112	168	224
1 ,,	15 ,,	37	60	105	170	255	340
1 ,,	25 ,,	37	60	105	170	255	340
⅔ ,,	35 ,,	60	100	145	270	405	540
⅔ ,,	90 ,,	95	153	265	420	630	840
4/10 ,,	110 ,,	140	220	370	650	975	1300
⅓ ,,	100 ,,	195	310	540	850	1275	1700
⅓ ,,	140 ,,	195	310	540	850	1275	1700
⅛ ,,	140 ,,	320	510	700	910	1360	1820
⅛ ,,	140 ,,	420	670	900	1200	1800	2400
1/16 ,,	170 ,,	600	870	1200	2000	3000	4000

POWELL AND LEALAND.

Object Glasses.	Angular Aperture.	Magnifying Power with the various Eye-Pieces. 1	2	3	4	5
2 inches	14 degrees	25	37	50	100	150
1½ ,,	20 ,,	37	56	74	150	220
1 ,,	30 ,,	50	74	100	200	300
⅔ ,,	32 ,,	75	111	150	300	450
½ ,,	70 ,,	100	148	200	400	600
4/10 ,,	80 ,,	125	187	250	500	750
¼ ,,	95 ,,	200	296	400	800	1200
,,	130 ,,	—	—	—	—	—
,,	145 ,,	—	—	—	—	—
⅛ ,,	100 ,,	250	370	500	1000	1500
⅛ ,,	140 ,,	400	592	800	1600	2400
1/25 ,,	145 ,,	600	888	1200	2400	3600
1/50 ,,	175 ,,	800	1184	1600	3200	4800
1/25 ,,	160 ,,	1250	1850	2500	5000	7500
1/50 ,,	150 ,,	2500	3700	5000	10000	15000

E 2; deeper, E 3; return from deep eye-piece to one of lower power, E.

The binocular prism is supposed to be employed in general; when it is to be withdrawn, and the instrument rendered monocular, M is used; the return to the binocular is indicated by B.

The illuminating apparatus first mentioned is that to be used if possible; that following, between brackets, may be used as a substitute.

The apparatus and materials constantly required, besides the microscope, are—

Lamp (vol. xx., p. 158).—A glass stage-plate; easily made by attaching a narrow slip of glass, with marine glue (vol. xx., p. 171), to a glass plate of convenient

dimensions, so as to form a ledge, and prevent objects slipping off when the stage is inclined.

Some 3 × 1 slides; a small stock of thin cover glass, in squares and circles; forceps; needles mounted in handles (vol. xx., p. 182); a few pipettes (vol. xx., p. 170), and some blotting-paper; a small quantity of alcohol and turpentine; and also a supply of water should be at hand.

The following books, being often referred to, will be quoted with abbreviated titles:—

Carpenter.—"The Microscope and its Revelations," by W. B. Carpenter, M.D. (4th edition, 1868.)

Beale.—"How to Work with the Microscope," by Dr. L. S. Beale, F.R.S. (1868.)

Hassall.—"Adulterations Detected," by A. H. Hassall, M.D.

(To be continued.)

GALVANOSCOPIC LANTERN.

By EDWIN SMITH, M.A.

Having occasion to exhibit to an audience some of my recent experiments on the electrical phenomena of plants, I was obliged to invent some means of throwing the image of the index of a sensitive galvanometer upon a screen. I did not want to use the electric light, or to add the weight of even a small mirror to the astatic needles; otherwise a bright spot of light might have been made to indicate the deflections on the plan of a Thomson's galvanometer. After a good many trials of various expedients I hit upon the following, which I found to answer my purpose admirably. It is an application of the principle of the magic lantern, and is at once simple and effective, It requires no stronger light than that afforded by a large belmontine lamp. The hands of the operator, not being wanted for troublesome adjustments of the illumination, are at liberty for the performance of his experiments. The apparatus is also inexpensive. No iron must, of course, enter into its structure: I made mine of wood with brass screws, only adding a copper chimney to the box which contained the lamp. The light thus enclosed is placed in the focus of a large condensing lens. A circular aperture is left in the lamp-box of the same size as the lens for that purpose. The rays being made parallel by the condenser fall upon a mirror behind, sloped at an angle of 45°, and are thus thrown upwards past the moving index of the galvanometer. This index, formed of the lightest possible stem of grass, is fixed at right angles to the upper needle, and projects horizontally over the lower mirror before mentioned. Just above the index, and in the top of the box, are placed the front lenses of a magic lantern, which throw divergent rays upon a second mirror, also inclined at a suitable angle, by which they are finally cast upon the white screen. It is best to adjust the lower mirror first with regard to the light, then to adjust the sliding lenses, till a distinct black image of the index is obtained stretching across a bright field. The front and the back of this apparatus may be made movable to enable one to get at the interior when necessary. An upright narrow case of cardboard, strengthened by two parallel ends of wood, should be placed so as to contain the arrangements for suspending the needles, and prevent gusts of air from disturbing them. Two mercury cups may be drilled behind the box in the thick board which forms its bottom, and which should project beyond the sides for the purpose of carrying three or four levelling-screws. Every part of the box, inside and outside, must be stained black.

I can strongly recommend the above contrivance to the notice of teachers and lecturers. A popular audience seems to understand the clock-like movements of a black finger upon a screen more readily than the linear motions of a bright spot. The spectators feel as if they saw the needle itself which is being deflected by voltaic currents.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

February 17th, 1870.

Dr. A. W. Williamson, F.R.S., &c., President, in the Chair.

The following gentlemen were elected Fellows:—R. T. Atcherley, T. W. Axe, A. H. Bateman, E. Francis, A. Prangley, W. Pritchard, L. B. Ross, T. G. Rylands, T. Wills, P. Wright.

An account was given by Professor Tyndall of his researches on "*The Action of Light on Gases and Vapours*," illustrated by a series of beautiful experiments.

Dr. Tyndall began by remarking that it had, for the last ten years, been his endeavour to make radiant heat a means of getting an insight into the working of the atomic forces, or, in other words, into the state which is called chemical combination. Whilst pursuing his experiments with luminous waves on matter in a finely-divided state, he was forced to imagine molecules and atoms; indeed, his belief in the existence of atoms is founded more upon those physical evidences than upon the considerations which are current in the chemical world. If he had to give up the notion of atoms, and to replace that conception by the abstract idea of multiple proportions, he would feel completely at a loss how to account for changes in the physical properties of matter. After these introductory remarks, the lecturer proceeded to the main subject. The apparatus which served to illustrate the statements consisted of a glass tube, about 3 feet in length and about 3 inches internal diameter, closed at each end by glass discs. This tube, after having been exhausted by an air-pump, was partially filled with dry air which had been permitted to bubble through the liquid whose vapours were to be examined. The condensed beam of an electric lamp was now caused to pass through the tube from end to end.

Since the aim of these experiments is to render visible the chemical action of light upon vapours, substances have been chosen, one, at least, of whose products of decomposition by light has so high a boiling-point that, as soon as it is formed, it is precipitated. Nitrous oxide gas, the vapours of amylic iodide, amylic nitrite, benzol, &c., mixed with some air which had passed through hydric nitrate or hydric chloride, were found well suited for this purpose. In all cases, no matter what the nature of the vapour was, if only employed in a sufficiently attenuated state, the visible action commenced with the formation of a blue cloud, which, in some instances, was of the deepest azure tinge, rivalling the colour of the purest Italian sky. When a cell containing some of the liquid whose vapours were to be examined was inserted between the lamp and the tube, no clouds were formed within the tube—the luminous waves traversing the liquid had been deprived of their acting power. When polarised light was sent through the tube, the blue cloud was visible only in one direction, the direction varying according to the position of the Nicol prism. When the short diagonal of the Nicol was vertical, the blue cloud was seen when the spectator's eye looked horizontally upon the tube, not otherwise. As soon as the prism was turned round its axis, the blue cloud was only seen when the line of vision fell vertically upon the experimental tube.

After concluding this account of this highly interesting subject, Professor Tyndall showed some of the experi-

ments bearing on his researches upon Dust, quite recently communicated at the Royal Institution.

The next meeting of the Society will take place on March 3rd, when Dr. Gladstone will deliver a lecture on "Indices of Refraction."

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 8, 1870.

J. P. JOULE, LL.D., F.R.S., President in the Chair.

MR. SPENCE repeated the experiment he had made at the Exeter meeting of the British Association, showing that the temperature of saturated saline solutions could be raised to their boiling points by merely passing through them ordinary steam at a temperature of 212°. Thus, a solution of chloride of sodium was raised to a temperature of 221°, and one of chloride of calcium to 248°. Chloride of sodium would have risen to 224·3° and chloride of calcium to 286° had the experiment been continued, but the point was sufficiently demonstrated that by steam of 212° much higher temperatures can be obtained.

GLASGOW PHILOSOPHICAL SOCIETY: (CHEMICAL SECTION).

Ordinary Meeting, February 14, 1870.

Mr. E. C. C. STANFORD, F.C.S., in the Chair.

THE first paper was on "*Some Notes on Californian Borax*," by Mr. Archibald Campbell, St. Rollox Chemical Works. The author referred briefly to the borax as obtained from Thibet under the name of tincal; and that of the Lagoons of Tuscany, and then he spoke of the boracic compounds obtained within the last few years in Peru. In the latter case, the deposit consists chiefly of borate, of lime with varying quantities of borate of soda. Having spoken at some length of the Peruvian deposits and of the opinions expressed by Mr. Walker (CHEMICAL NEWS, vol. xviii., p. 203), regarding their origin, Mr. Campbell stated that borax had lately been found at Halberstadt in Transylvania, in Ceylon, in several mineral springs in Canada East, and in the waters of the sea along the coast of California. The most important discovery of borax in recent years is that of the Borax Lake of California, a description of which was given by Mr. Campbell. It is about 40 miles from the Pacific, and 60 miles from Suisum Bay. Between it and Clear Lake (a lake about 25 miles long) there is a large accumulation of volcanic materials, containing much obsidian and pumice-stone, lying loosely heaped together in a ridge which separates the two lakes; in fact, all through the mountain ranges on the coast in the region under notice, there are hot springs and the remains of solfatara action. These strongly indicate a cross fracture, through which the volcanic agencies have made themselves perceptible, and which probably forms a connection on the south-west with the geysers, thus forming a line of volcanic action nearly, if not quite, across the mountain chain. It is in this peculiarly volcanic action that the Borax Lake is situated. The lake is of variable size, according to the season of the year and the comparative dryness of the season. In September, 1863, the water occupied an area about 4000 feet long, and 1800 feet wide in the widest part. Its length has been twice as great as it is at present, as is evident from the nature of the ground. In some very dry seasons, the lake is rendered entirely dry: in September, 1863, however, the water was about 3 feet deep. The existence of the lake was first made known to the world by Dr. Veatch, who examined it in September 1856, and detected borax in its waters. It was not until some months afterwards that the existence of a large bed of borax crystals was discovered in the bottom of the lake. The land in the district belongs to the California Borax Company.

The water collected from the lake in 1863, on being analysed, was shown to contain 2401·56 grains of solid matter per gallon, of which about one-half was common salt, one-fourth carbonate of soda, and the remainder chiefly borate of soda—there being 281·48 grains of the anhydrous borate, equal to 535·08 of crystallised borax to the gallon, or, in other words, 13 gallons of the water are equal to 1 lb. of the borax crystals. Traces of iodides and bromides were also found. A sample of water taken from a coffer-dam sunk in the middle of the lake was more concentrated. There were 3573·46 grains of solid matter per gallon; but the same ingredients were found, and in nearly the same proportions as in the water of the lake itself. The crystals vary in size, from those which are microscopic to such as are 2 or 3 inches across. They are mixed with bluish mud, and sometimes there are several alternating layers of mud and crystals of borax. It is believed that there are several thousand tons at the bottom of the lake. The crude borax is obtained so pure that it is used by the San Francisco assayers in preference to the refined borax imported from abroad. In the neighbourhood of the lake, there is a hot spring of a remarkable character, and said to yield about 300 gallons per minute. Mr. Campbell gave the following analysis of the water of the spring, the figures representing grains per gallon:—

Chloride of potassium	trace
,, ,, sodium	84·62
Iodide of magnesium	0·09
Bromide of magnesium	trace
Bicarbonate of soda	76·96
,, ,, ammonia	107·76
Biborate of soda	103·29
Sulphate of lime	trace
Alumina	1·26
Carbonic acid (free)	36·37
Silicic acid	8·23
Matter volatile at a red heat ..	65·77
	484·35

These figures necessarily represent anhydrous salts and, therefore, the 103·29 grains of biborate of soda represent 195·35 grains of crystallised borax.

The author had not ascertained the temperature of the spring, but it could not be high, owing to the great amount of bicarbonates, and from carbonic acid present in solution. He considered the most extraordinary feature of the analysis to be the very large quantity of ammoniacal salt present—exceeding, he believed, that of any spring yet analysed.

Mr. CAMPBELL afterwards read a short paper on "*Notes on Silician Sulphur.*" He gave an account of the mode in which sulphur is distributed in nature, and of the various theories held regarding the formation of sulphur deposits. Some peculiar properties of sulphur were next spoken of; and the author concluded by mentioning some details regarding the means adopted for the extraction of the sulphur from the mineral masses in which it occurs in Sicily.

The author exhibited several specimens of Californian borax and Silician sulphur. A short discussion followed, the remarks being especially directed to the peculiarities of the analysis given above and the probable source of the nitrogen of the ammonia.

The next communication was entitled "*On the Composition of Ooze or Chalk Mud from the Atlantic Sea Bed,*" by Mr. JAMES MAHONY.

The author spoke of the interest that has been felt regarding the nature of the Atlantic sea bottom, and the conditions of life there present, ever since the first surveys

were made in connection with the Atlantic telegraph cable. Previous to that time Professor Edward Forbes had expressed the opinion that organised beings could not live at greater depths than 200 fathoms; but Dr. Wallich had shown that animal life did exist even at a depth of 1260 fathoms, and that it was represented by various species of starfish and *Globigerina*; and, further, that the comparatively level plateau extending from Ireland to America was covered by a fine white mud, to which the name of "ooze" had been given. Mr. Mahony then referred to the deep-sea dredging expeditions of H.M.S. *Porcupine*, and stated that he had been favoured with a sample of the ooze lately sent to a scientific friend in Glasgow, by Professor Wyville Thomson. It was obtained from the deepest dredging, 2435 fathoms, about 150 miles west of Ushant, the temperature of the sea bottom being 36·5°. Part of the sample was air-dried and a small portion was put, when fresh, into methylated spirit. Mr. Mahony had examined the ooze both as a chemist and as a naturalist. The following is the analysis:—

Silica	26·60
Peroxide of iron and phosphates	3·80
Protoxide of iron	0·08
Carbonate of lime	58·80
Carbonate of magnesia	1·76
Sulphate of lime	trace
Soluble salts	4·20
Organic matter	2·30
Water	2·50
	100·04

The silica was found under the microscope to consist chiefly of minute structureless fragments, some of them being crystalline. A small number of diatoms were also found. The calcic carbonate consisted of larger organisms (class *Foraminifera*), some still containing the small particle of jelly-like matter constituting the animal substance of these organisms, and called *sarcode* by Dujardin. These doubtless yielded the organic matter noted in the analysis. The soluble salts were accounted for by the evaporation of the sea water with which the mud was charged when taken up.

Mr. Mahony then considered the question—"Does the presence of the gelatinous contents of the foraminifers indicate that they live and die on the sea bottom?" So far as the aëration of the water was concerned, he found no difficulty, especially when looking at the subject in the light thrown upon it by Mr. John Hunter's recent paper "On Analysis of Sea-Water Performed on Board the *Porcupine*" (*Journal of the Chemical Society* for January, 1870). He concluded his paper by stating that over the North-Atlantic sea-bed the chalk formation is in continued progress, the identity of the ooze with chalk, both chemically and organically, being very apparent. The siliceous grains have their counterpart in the layers of flint seen in the chalk cliffs,—probably formed by the aggregation of minute particles round a central nucleus,—while the species of minute shells found in the ooze are in many cases identical with those entombed long ages ago.

A short discussion followed, and then Mr. Stanford vacated the chair to read two short papers. The first was entitled "*Note on a Specimen of Shell Sand from the Island of Coll.*" The specimen examined had the following analysis:—

Carbonate of lime	68·50
Carbonate of magnesia	1·51
Silica sand	25·69
Phosphates, iron, and alumina	2·00
Organic matter	2·30
	100·00

It was very much agglutinated, owing to the carbonate of lime which the rain-water had taken up and afterwards deposited over the exposed grains of sand. The author mentioned that most of the islands of the Outer Hebrides have similar deposits of sand on their west coast, the east being covered with peat. The sand is generally composed almost entirely of the the *débris* of shells of countless generations of mollusca. In the silica sand mentioned in the analysis there was felspar, and therefore potash. A trace of nitrogen was present in the organic matter. The specimen was much weathered, and, therefore, did not contain as much nitrogen as there would doubtless have been in the fresh state. Where the sand does not "blow" it bears a luxuriant crop of white clover, which is specially remarkable in North and South Uist. The presence of magnesia shows it to be a good food for clover. By mixing the shell sand with the peat an excellent soil is produced. With lime it forms a remarkably strong mortar, almost equal to a cement.

Mr. Stanford's next paper was a "*Note on Iodide of Cyanogen*," the result of the examination of a specimen of that compound which he had recently found while resubliming a lot of inferior iodine purchased in London. Although the impurity was said to be a common one, he had never met with it in any quantity before. Mr. Stanford detailed its properties and its reactions.

MISCELLANEOUS.

Chemical Society.—The following is the Council's list for the election of officers on March 30th, 1870:—President—A. W. Williamson, Ph.D., F.R.S. Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., V.P.R.S.; Lyon Playfair, M.P., Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S. Vice-Presidents—E. Frankland, Ph.D., F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; A. Matthiessen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D. Secretaries—A. Vernon Harcourt, M.A., F.R.S; W. H. Perkin, F.R.S. Foreign Secretary—H. Müller, Ph.D., F.R.S. Treasurer—F. A. Abel, F.R.S. Other Members of Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; David Forbes, F.R.S.; F. Field, F.R.S.; Dr. M. Holzmann; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; A. Voelcker, Ph.D.

Flower Farms—Premiums for Odours of Plants.—The following premiums have been placed at the disposal of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, for the term of seven years, by Dr. Septimus Piesse, F.C.S.:—1. A premium of £5, for one pound of otto of bergamot, of the value of 16s. or more in the London market, being the produce of plants (*Citrus Bergamia*) grown in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency. 2. A premium of £5, for 1 oz. of otto of roses, of the value of £1 or more in the London market, being the produce of any variety of roses grown together in one plantation in the above-mentioned Colonies. 3. A premium of £10, for a canister of enflowered butter or fat, so scented with any kind or sort of flower, either by infusion or enfleurage, or by means of these processes jointly, of the weight of 3 lbs. or more, and of the value of 6s. per lb. in London; the said butter or fat to be enflowered or infused with flowers grown for the purpose in the British Colonies.

On the Use of Ether as an Intoxicant in the North of Ireland.—We have received from Mr. H. N. Draper a pamphlet on the above subject from which we learn that the use of methylated ether instead of alcohol is very general in the counties of Londonderry, Antrim, and Tyrone. The quantity taken at one time is from two to four drachms and the dose is repeated twice, thrice, or even four and six times daily. Mr. Draper treats the

subject in its relation to the Inland Revenue and also to insurance companies, the former suffering by the practice to the extent of £5666 per annum, while the risks of the latter are increased by such an inflammable liquid being stored and handled by people ignorant of its properties.

Water Supply of London.—We have received from Dr. Letheby his report on the sanitary condition of London, in which he says the chemical composition of the metropolitan water has not fluctuated to any considerable extent; for that derived from the Thames and the Lea has contained from 21 to 23 grains of solid matter per imperial gallon during the winter months, when the rainfall is the greatest, and from 17 to 17·5 grains per gallon in the summer, when it is least, the average for the whole year being about 19·3 grains per gallon, of which about 14·2 grains are calcareous salts, giving that degree of hardness to the water, the hardness being reduced to about 3·8 degrees by boiling the water for a quarter of an hour. The proportion of common salt in the water does not exceed 1·8 grains per gallon, and the organic matter, as estimated by the oxygen required to oxidise it, is not above two-thirds of a grain per gallon. The nitrogenous matter also is remarkably small, ammonia being in the proportion of only one part to about 35,000,000 parts of water, and the nitrogen, as nitrates, &c., as one to 630,000 parts. The water supplied to the public is for the most part clear and colourless; on one occasion, however, during the year, it was slightly turbid in the case of the Grand Junction water; on two occasions with the Southwark and Vauxhall water; on four with the Lambeth; and on six with the Chelsea. The daily supply of water to the metropolis has ranged from 91,578,341 gallons per day, in the month of January last, to 110,094,058 gallons in the month of July, the average for the whole year being rather more than 99,000,000 of gallons per day, or 31·2 gallons per head of the population. The daily supply to Paris averaged 46,561,472 gallons per day, or 24·6 gallons per head of the population; but this includes the water supplied to the public fountains, ornamental waters, &c. The number of houses supplied daily by the water companies of London is about 463,000. Rather more than half of the water is obtained from the River Thames at Hampton, and the rest is from the Lea, and from springs and wells in the chalk. The supply to Paris is derived chiefly from the Canal d'Ourcq and the River Seine. None of the Paris water is filtered, and is always more or less turbid when it reaches the consumer. In London, however, the water is filtered, generally in a very effective manner. It is remarked that, except in special cases, water of moderate hardness, like that supplied to the metropolis, to Paris, and Vienna is always preferred, and is best suited for domestic purposes, because of its being brighter to the eye and more agreeable to the taste. So satisfied, indeed, were the French authorities on this head, that they passed by the soft waters of the sandy plains near Paris, and went far away to the chalk hills of Champagne, where they found a water which is even harder than that supplied to London. One important consideration which strongly influenced them in their decision was the fact that more conscripts are rejected in the soft-water districts, on account of imperfect development and stunted growth, than in the hard; and they conclude that calcareous matter in water is essential to the formation of tissues. In this country, also, it is remarkable that, wherever soft water is supplied to the people, the mortality is large, even when allowance is made for the birth-rate of the place. Glasgow, for example, as well as Preston, Dundee, Sheffield, Plymouth, Manchester, Bradford, &c., which are all supplied with water of less than 4 degrees of hardness, have a mortality which ranges from 26 to 34 per 1000, while at Birmingham, Bristol, Sunderland, Newcastle-on-Tyne, Wakefield, Dover, Norwich, Croydon, Worcester, Derby, and other places, where the waters are hard, the mortality is considerably less; in fact, it may be said that in towns supplied with water of more than 10 degrees of hardness, the average mortality is about 22 per 1000, while in those supplied with softer water it is about 26 per 1000. It may well be, as the late Professor Johnson observed, that "the bright sparkling hard waters which gush out in frequent springs from our chalk and other limestone rocks are relished to drink, not merely because they are grateful to the eye, but because there is something exhilarating in the excess of carbonic acid they contain and give off; and because the lime they hold in solution removes acid matters from the stomach, and thus acts as a grateful medicine to the system. To abandon the use of such a water, and to drink daily in its stead one entirely free from mineral matter, so far from improving the health, may injure it. The water of a country may determine the diet of its inhabitants. The soft water of the lakes of Scotland may have had much to do with the use of brown meal; and but for the calcareous waters of Ireland the potato could not have become a national food." Looking at the plain teachings of all this, and considering the excellent quality of the water supplied to this metropolis, it would be folly, in my opinion, to change it for a soft water. On the other hand, it is quite possible to have an excess of calcareous and other saline matters, as is the case with the well waters of this city, where the proportion ranges from 48 to 120 grains per gallon. Dr. Letheby concludes with a report of the sanitary work done in the city during the year.

CORRESPONDENCE.

MONAD ELEMENTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxi., p. 80), Mr. George Davis has touched upon a subject especially interesting to me, as, during the last thirteen months, I have made it my study. Many circumstances (among which a prolonged absence in the country, away from all books of reference, and a wish to collect more and more evidence in their support) have combined to defer the publication of my views of the so-called monad elements; I hope, however, now speedily to make them known. I may shortly state that, by assuming triad functions for the univalent class of bodies, I have been able to explain the existence of many compounds hitherto unclassified and regarded, as Mr. Wanklyn says, as "freaks of nature."—I am, &c.,

WALTER NOEL HARTLEY.

Dr. Odling's Laboratory, Royal Institution,
February 23rd, 1870.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, February 14, 1870.

This number contains the following papers relating to chemistry and allied sciences:—

Galvanic Element with Three Fluids.—F. Zaliwski.—This contrivance consists of two porous cells placed one inside the other and surrounded by another suitable vessel. The inner vessel contains

nitric acid and a piece of carbon; the intermediate vessel contains sulphuric acid; and the outer vessel a solution of sal-ammoniac in water and a piece of zinc. The author states that this arrangement is very superior to a Bunsen cell.

Accidental Images of White-Coloured Objects.—J. M. Seguin.—A continuation of a former paper on this subject.

Geological and Agronomical Map of the Département de la Haute-Vienne.—J. Mallard.—M. Elie de Beaumont calls the attention of the meeting to this map, on account of the excellent manner in which it has been executed by means of chromo-lithography. The description given is too lengthy for full reproduction here; but the utility of such local maps, executed with minute accuracy and on a large scale, must be evident.

Fusion of Platinum.—Dr. St. Claire-Deville states that an error has accidentally been made in the *Compte Rendu* of the last meeting, and that it is the oxygen, not the hydrogen, dissolved during the fusion of platinum, which gives rise to this metal, presenting the same phenomenon as molten silver—viz., scintillation and spirting while in the molten state.

New Electro-Magnetic Apparatus.—A. Demoget.

Description of an Apparatus for Registering, by Photography, the Reading of the Barometer.—P. Volpicelli.

Historical Notes on the Radiation of Heat from the Moon.—P. Volpicelli.—After referring to the opinions of Virgil, Dante, Tasso, Marini and Guarini, who denied the possibility of heat emanating from the moon, the author quotes, from the works of Aristotle, Aquino, Pic de la Mirandolle, and Cardan, who, although not enabled to prove, experimentally, any facts relating to this matter, yet admitted that heat emanated, to some degree, from the moon. Dr. Hooke was the first who called attention to this subject, by some observations and experiments; and Geminio Montanori (born, 1632; died, 1687) states, in his "L'Astrologia Convinta di Falsità," that the heat emanating from the moon can be readily made perceptible by means of a large air thermometer and a powerful lens. In our days, the author says, it was Melloni who, on the 23rd of March, 1846, has incontrovertibly proved, by experiments, that the moon radiates heat.

Double Crystals Exhibited by Snow.—J. Girard.

Action of Green Light upon the Mimosa Pudica.—P. Burt.—The plants are placed under glass jars constructed of variously-coloured glass. The chief fact observed in respect of these very sensitive plants is that, by being covered with a green-coloured glass jar, the plant rapidly becomes insensible, and dies in a very short time.

Solar Spots Visible by the Naked Eye.—Tremeschini.—By simply making use of a coloured glass, the author states that these spots can be seen very well; the diameter of the largest was, on the 11th instant at 9 a.m., 0° 3'45', and on the 14th at 10 a.m., 0° 4'50'.

By far the greatest portion of this number is occupied by essays on geometrical, mechanical, and mathematical subjects; and there is no paper strictly relating to chemistry.

Journal für Prahtische Chemie, No. 16, 1869.

This number contains no original papers.

No. 17, 1869.

On the Lead Salts of Formic Acid.—Dr. Barfoed.—The author describes:—Neutral formiate of lead.—According to what is stated on the solubility of this salt in treatises on chemistry, it is soluble in 36 parts of water; but, according to the author's experiments, this salt, prepared with proper care, requires for solution 63 parts of cold water, while it requires 5½ parts of boiling water for solution. This salt is, moreover, gradually decomposed by being boiled; formic acid escapes, and a basic salt remains. Bibasic formiate of lead is obtained when an aqueous solution of the neutral salt is treated with its equivalent weight of oxide of lead; it is readily obtained in large crystals, which are, however, easily acted upon by the carbonic acid of the air. The formula is $2PbO,C_2HO_3$. 1 part of this substance requires 58·5 parts of cold and 10 parts of boiling water for solution; it is insoluble in alcohol, as is likewise the neutral salt. Tribasic formiate of lead is obtained by boiling a solution of the neutral salt with 2 equivalents of oxide of lead; this substance is obtained in small acicular crystals, soluble in 25½ parts of cold, and 7½ of boiling, water; formula, $3PbO,C_2HO_3$. Quadribasic formiate of lead, $4PbO,C_2HO_3$.—1 part of this salt requires 104 parts of cold water for solution; it is insoluble in alcohol.

Estimation of Nitric Acid in Spring Waters.—Dr. Fleck.—The method, described at great length, is based upon the fact that, according to the author, the nitric acid present in spring waters is chiefly combined with lime or magnesia, and rarely only with alkalies. Use is made of the well-known fact that a solution of sulphate of potassa yields, when mixed with a solution of nitrate of lime, gypsum and nitrate of potassa, which, in its turn, when ignited in the presence of organic substances, is converted into carbonate of potassa; while, lastly, the carbonate of potassa thus formed can be quantitatively estimated and is proportional to the quantity of nitric acid present. The reagents required for the execution of this method are—Normal nitric acid and normal caustic soda solution, each at from 4 to 5 per cent; a solution of sulphate of potassa, 5 grms. to 100 c.c. of water; perfectly pure sugar. According to the statements made in this lengthy essay, this method appears to be a useful addition to quantitative chemical analysis.

A New Salt from Hallstadt (Austria).—Dr. Simony.—This mineral occurs along with rock-salt, anhydrite, and a somewhat weathered sulphate of soda; its colour is bluish green; formula, $MgSO_4,Na_2SO_4,4H_2O$. This salt is not affected by exposure to air, and loses, even at 100°, only a portion of its water. Although, therefore, this salt has the same percentage composition as astrakanite, it has a different constitution. The three now known naturally-occurring double salts of the sulphates of soda and magnesia are, therefore—

$MgSO_4,Na_2SO_4,4aq$, astrakanite, or Bloedite;

$2MgSO_4,2Na_2SO_4,5H_2O,3aq$, Simonyite (the salt just discovered);

and $2MgSO_4,2Na_2SO_4,5H_2O$, Loewite.

Synthesis of Hydroxylamine.—Dr. Ludwig.—The author has succeeded in directly combining nascent hydrogen and deutoxide of nitrogen, $NO+H_2=NH_3O$. This is effected by passing pure deutoxide of nitrogen through a mixture of tin and hydrochloric acid; the tin is removed by sulphuretted hydrogen, the filtrate is evaporated to dryness, and the residue taken up with alcohol. The chloride of ammonium is removed by chloride of platinum, and the hydroxylamine is precipitated with pure anhydrous ether.

Action of Chlorine upon Absolute Alcohol while Exposed to Direct Sunlight.—MM. Streit and Franz.—While engaged in making hydrate of chloral with absolute alcohol, direct sunlight accidentally fell upon the apparatus, the temperature of the contents of which was 62°. The continued action of the sun's rays caused a series of sharp detonations, accompanied by very bright lightning-like flashes inside the apparatus; the fluid, previously quite clear, became black, a blackish powder was separated, and the temperature rose to 78°. The authors repeated the experiment with artificial light, and found that magnesium light, the light emitted by a mixture of sulphide of carbon and deutoxide of nitrogen while burning, electric light, and the light emitted by the ignition of a mixture of chlorate of potassa and sulphur, when ignited produce the same effect. The products of the decomposition of the alcohol were not further investigated, but exhibited a most frightful stench and a deep reddish brown colour.

Revue Hebdomadaire de Chimie, February 10, 1870.

Process for Rendering Various Substances Waterproof.—M. Ch. Toppan.—This contrivance consists, essentially, in the employment of a solution of pure paraffin in naphtha—that is to say, light petroleum oil—and to steep the objects required to be waterproof in this solution.

Estimation of Starch in Bread.—J. Mayer.—The method proposed by the author is that of converting the starchy matter into glucose, by means of boiling, say 5 grms. of the bread, with water containing 1-20th of its weight of sulphuric acid. The liquid is kept boiling for a considerable time, and from time to time a small quantity is tested with iodine; when, as the latter substance fails to indicate the presence of starch, ebullition is kept up for some time longer, and the glucose which is formed is estimated by Fehling's process. A too weak acid should not be applied, nor, also, a stronger, as both are, according to the author, equally injurious to the accuracy of the results.

On Diamonds.—M. F. Rambosson.—This paper, an abstract of a printed book just published, is accompanied by an engraving representing the most celebrated of these precious stones. No mention is, however, made of the largest diamond ever yet found, which once belonged to the Rajah of Mattan, Borneo, but is now in the possession of the Netherlands' Government; this jewel, as yet uncut, however, has a flaw (a very common thing for large diamonds—for instance, the Koh-i-noor), which very materially impairs its value. This stone weighs 367 carats (upwards of 3 ozs. troy), and is egg-shaped.

Bromoform, Bromal, and Iodal compared with Chloroform and Chloral.—Dr. Rabuteau.—This paper is the record of some experiments made with these substances to test their anæsthetic value.

Cosmos, February 12, 1870.

Imperial Observatory at Paris.—By the same decree which relieves M. Le Verrier from his functions as Director of the Observatory, the provisional management and chief control of that establishment is placed in the hands of a committee of three gentlemen—viz., Vice-Admiral Penhoat; M. Combes, Member of the Institute; and M. Balard, Inspector-General of Superior Public Instruction.

Explosion of a Dynamite Manufactory.—This took place at Dunwald, near Cologne, a few days ago. The quantity of material exploded was only about 100 kilos.; but the destruction of life and property for a great distance around the spot was such as could hardly have been affected by thirty times as much gunpowder.

Dangers of Arsenical Green Pigments.—The Prefect of Police of the Seine (Paris and environs) has very properly issued a notice calling attention to the great danger attending the use of these pigments for imparting colours to the edges of books and various articles of stationery, to which these, specifically, very heavy materials are merely fixed, either by thin glue-water or gum. It is a well-known fact, the police notice says, that, even when mixed with linseed oil, these pigments are liable to become loose and pulverulent (unless peculiar precautions be taken); and they are altogether unsuitable for the purposes just named, since they dust off, and thus may be inhaled and cause derangements of health. The manufacturers of the articles alluded to are, if they continue this practice after this day, amenable to legal proceedings, correctionally as well as *en matière civile* (liable for action for damages).

February 19, 1870.

University of Heidelberg.—This, the most ancient of Germany except the Universities of Prague and Vienna, was founded in 1386, and has always been a first-rate establishment and of high standing in physical science. Helmholtz, Bunsen, Kirchhoff, Hofmeister and others have been and are among the bright gems of this scientific institution, which has a teaching staff of 80 men and an average number of from 400 to 600 students.

Rendering Tissues Waterproof (Imperméables). — V. Meunier.—1 kilo. of alum is dissolved in 32 kilos. of water, and 1 kilo. of acetate of lead is dissolved in the same quantity (separately) of water. The two liquids having been mixed, there is, of course, precipitated sulphate of lead; as soon as this is deposited, the clear liquid is decanted, and the fabric which it is desired to render waterproof is thoroughly steeped in this fluid, and next dried by being hung up in open air.

Moniteur Scientifique, No. 316, February 15, 1870.

This number contains the following original papers and memoirs pertaining to chemistry:—

Peat from Avigliana, near Turin, Italy.—Dr. Fino.—Close to the Mont Cenis railway tunnel, in the valley of Susa, an enormous deposit of peat is found which, since fuel of any kind for industrial purposes is scarce all over the Italian soil, is largely used. The authors have analysed four different samples of this fuel, viz.:—The top layer, or light peat, containing, in 100 parts—Water (driven off at 100°), 44·19; volatile combustible matter, 36·44; coke, 16·44; ash, 2·93. Middle layer—Water, 38·10; volatile combustible matter, 36·09; coke, 20·89; ash, 4·92. Lower layer, compact black peat—Water, 32·41; volatile combustible matter, 36·23; coke, 21·22; ash, 10·14. Artificially-compressed very hard black peat—Water, 26·89; volatile combustible matter, 38·38; coke, 22·41; ash, 12·32. The average composition of the ash of these peats (containing, on average, after drying, 11·37 per cent thereof) is, in 100 parts—Silica and clay insoluble in HCl, 37·61; silica soluble in HCl, 0·85; protoxide of iron, 5·30; peroxide of iron, 10·22; alumina, 7·0; lime, 24·61; magnesia, 1·40; sulphuric acid, 3·04; traces of HCl, KO, NaO, and loss, 0·61; carbonic acid, 0·36. The utilisable calorific value of sample 1, in wet state, is 1836; No. 2, 2172; No. 3, 2391; No. 4, 2515.

Mineral Magnesian Water from Bertinaro.—M. F. Sestini.—When recently taken from the spring, this water is perfectly limpid, and keeps so in well-corked bottles. When exposed for some time to the air, a white sediment is deposited; taste, bitter saline; exhibits a slight hydrosulphuric odour; does not affect litmus paper, but reddens turmeric paper slightly. 1 litre of the water contains—Chloride of magnesium, 1·71 grms.; chloride of sodium, 7·027; chloride of potassium, a trace; sulphate of soda, 0·368; sulphate of lime, 0·639; bicarbonate of lime, 1·83; alumina, ferrous oxide, and phosphoric acid, 0·016; silica, 0·012; organic matter and ammonia, 0·746;—total, 12·348 grms.

Ammonia Gunpowder.—M. A. Jouglet.—The owners of the Nora-Gyttorp Powder Mills, Sweden, have brought out a new kind of powder, which contains, it appears, a mixture of nitrate of ammonia and nitrate of potassa (with what other substances is not said). This material is, according to some accounts, a more powerful explosive than nitroglycerine, and cannot be ignited, or made to explode, but by the impact of a blow, or a falling weight, or by the detonation of a small cartridge containing common gunpowder. Experiments made at a military establishment at Berlin with this powder have proved that, while ordinary gunpowder, gun-cotton, nitroglycerine, and dynamite take fire the moment flame is approached, this powder did not do so. As regards the effect of the impact of a blow of a falling weight (the same, of course, in each case), ordinary gunpowder requires for explosion that the weight falls from a height of between 4 and 5 ft.; nitroglycerine, 1¼ ft.; dynamite, 2⅝ ft.; and ammonia gunpowder, between 12 and 15 ft. A sample having been sent to France from Berlin did not, the author says, confirm the high opinion this substance is thought worthy of in Prussia.

Waterproofing Paper.—M. A. Jouglet.—The solution of oxide of copper in ammonia acts, as is well known, as an energetic solvent upon cellulose; this property is made use of to waterproof paper in the following manner:—A tank is made to contain the solution just alluded to, and the paper is rapidly passed just over and in contact with the surface of the liquid, by means of properly-placed rollers moving with speed. The paper, on leaving, is pressed between two cylinders, and next dried by means of so-called drying cylinders, similar to those in use in paper mills. The short contact of the felty paper tissue with the liquid gives rise to just sufficient solution of cellulose to form an impermeable varnish.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 3, 1869.

The only paper relating to chemistry in this number is a lengthy one:—

Chlorinated Derivatives of Toluol.—Drs. F. Beilstein and A. Kuhlberg.—The authors have divided their memoir into the following sections:—Isomeric tetrachlorotoluols—

$CH_3.Cl_4.CH_3$, $C_6H_2Cl_2.CH_3Cl$, $C_6H_3Cl_2.CHCl_2$, and $C_6H_4Cl.CCl_3$;

isomeric pentachlorotoluols—

$C_6Cl_3.CH_3$, $C_6HCl_4.CH_3Cl$, $C_6H_3Cl_2.CHCl_2$, and $C_6H_2Cl_2.CCl_3$;

isomeric hexachlorotoluols—

$C_6Cl_3.CH_3Cl$, $C_6HCl_4.CHCl_2$, and $C_6H_2Cl_3.CCl_3$;

isomeric heptachlorotoluols—

$C_6Cl_3.CHCl_2$ and $C_6HCl_4.CCl_3.C_6Cl_3.CCl_3=C_7Cl_8$.

There is added to this memoir an extensive tabulated review of all the compounds treated of, exhibiting their boiling-point, specific gravity, percentage composition, crystalline shape, melting-point of the solid substances and formulæ.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, 1869.

This number opens with a beautifully-executed and very good photographic likeness of the late lamented Thomas Graham, represented as he was known to us in the later days of his life. A full biography of the deceased, from the hand of his friend Dr. A. W. Hofmann, forms a conspicuous and valuable portion of this number, which contains the following original papers and communications:—

Various Reactions Exhibited by the Salts of Oxide of Copper (Black Oxide) when Cyanogen Compounds are Present.—Ed. Schaer.—This very lengthy paper is reserved for future communication in full.

Synthesis of Aromatic Acids.—Th. Zincke.—Referring to the observation of Dr. Wislicenus, that minutely-divided silver is one of the best means for the concatenation (verkettung) of carbon atoms, the author imagined that this might be also useful for the synthesis of aromatic acids. He describes, at very great length, his experiments, beginning with α toluolic acid, phenylo-acetic acid; but, instead of applying silver, use has been made of very minutely-divided copper. The ethyl-ether of the acid just alluded to was heated, along with bromide of benzol and copper, to from 180° to 200°, in a sealed tube. After a lengthy and complicated process of purifying, a sufficient quantity of pure material was obtained to test its properties, which are—A solid crystalline body, fusing at 76°, subliming at a higher temperature, without decomposition, and difficultly soluble in cold, but more readily so in hot, water. The analysis of the silver-salt and the products of oxidation by means of chromic acid, yielding carbonic acid and benzoic acid, prove the perfect identity of the substance as α toluylic acid. Synthesis of phenyl-propionic acid.—The author thought that it might be possible to withdraw from monochloro-acetic acid and chloride of benzyl, the chlorine, by means of copper or silver, and to obtain an acid, $C_6H_5.CH_2CH_2COHO$—that is to say, β phenyl-propionic acid; but the results of a series of experiments did not confirm this view; and the body chiefly produced is a substance insoluble in alcohol, whether cold or hot, difficultly soluble in ether, and slightly better soluble in benzol, chloroform, and sulphide of carbon, from all of which solutions it is only obtainable as an amorphous, brittle resin, exhibiting, even in its dilute solutions, a bluish fluorescence similar to that exhibited by solutions of quinine. Energetic oxidising substances are, even at boiling heat, without any action upon this substance, which yielded, by elementary organic analysis, in 100 parts—C, 92·98; H, 6·72; formula, C_7H_8. When chloride of benzyl is diluted with twice its bulk of any hydrocarbon boiling at 130°, and then treated as above described, an aromatic oily substance is obtained, which the author reserves for further investigation.

Chlorocarbonate and Carbaminate of Phenol.—Th. Kempf.—Referring to his former researches on this subject, the author states that he has obtained a compound—

$$C_7H_7NO_2 = CO\left\{\begin{matrix}H_2N\\OC_6H_5\end{matrix}\right.$$

fusing at 141°; soluble in water, alcohol, and ether; and yielding, on evaporation of these solutions, a crystalline substance; when heated to about 150° with a saturated solution of ammonia in water, phenol is formed, and urea.

Estimation of the Quantity of Sulphide of Carbon in Coal Gas.—A. Vogel.—The author first alludes to the great perfection the purifying process of coal gas has attained (at least, abroad, where gas-works are under very severe inspection, and especially so in the country this author hails from—viz., Bavaria), so that coal gas may be made to pass for several consecutive hours through a solution of a lead-salt without affecting it in the least. As to the presence of sulphide of carbon (which, by the bye, the author remarks, owes its formation very much to defective care, in respect of the temperature applied to the retorts, as well as to unsuitable selection of the qualities of coal), it can only be present in small quantity, and therefore its detection, as well as its estimation, become rather more difficult. The plan suggested and experimentally tested is the following, based upon the simple fact that, when pure metallic copper is in contact with gas containing sulphide of carbon, sulphuret of copper is formed:—Coal gas, purposely purified from every trace even of sulphuretted hydrogen, was caused to pass over bright metallic copper for several hours. The surface of the metal having assumed an iridescent hue, the copper was washed with dilute nitric acid; and, a solution of a salt of barium having been added to this acid solution, a precipitate of sulphate of baryta was obtained after some hours' standing. It is, of course, absolutely required to use pure reagents, and insure the freedom of the copper from any sulphur.

Constitution of Isatine, Isatinic Acid, and Indol.—Aug. Kekulé.—This paper contains a lengthy hypothetical discussion on this subject in reference to the researches of MM. Baeyer and Emmerling and the author's own.

From the *procès verbal* of the annual general meeting of this Society, we learn that it now numbers 408 members—viz., 137 home and 271 foreign—including a great many Germans resident beyond the limits of the North Germanic confederation. It has extended its corre-

spondents to the chief countries of Europe and America, and possesses an already valuable library, while its financial position is all that can be desired.

Revue des Cours Scientifiques de la France et de l'Etranger, February 19, 1870.

This number contains an excellent paper—

Lecture on the Mechanical Forces—M. A. Cazin; but no papers at all relating to chemistry.

The American Journal of Science and Arts, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Relation between the Intensity of Light produced from the Combustion of Illuminating-Gas and the Volume of Gas Consumed.—B. Silliman.—This lengthy paper contains valuable information on this subject, and a detailed description of a series of experiments made with a view to prove, among other matters, also this theorem—that the intensity of gas-flames (*i.e.*, illuminating power) increases, within the ordinary limits of consumption, as the square of the volume of the gas consumed. The chief point of interest for the consumer of gas to be deduced from the data here presented is that, where it is important to obtain a maximum of economical effect from the consumption of a given volume of illuminating-gas, this result is best obtained by the use of burners of ample flow.

Principles of Molecular and Cosmical Physics.—W. A. Norton.—A lengthy philosophical essay.

New Method of Separating Tin from Arsenic, Antimony, and Molybdenum.—F. Wigglesworth Clarke.—Reserved for full reprint at a future date.

Contributions to the Chemistry of Common Salt, with particular Reference to Our Home Resources.—C. A. Goessmann.

Account of a Fall of Meteoric Stones near Danville, Ala., with an Analysis of the Same.—J. Lawrence Smith.—This stone fell on Friday, November 27th, 1868, at about five o'clock p.m., at Danville (about lat. 34° 30′ N., and long., 87° W. of Greenwich). The iron, separated with great care from the pulverised meteorite, constitutes 3·092 per cent; and, on analysis, furnished—Iron, 89·513; Nickel, 9·050; cobalt, 0·521; copper, a minute quantity; phosphorus, 0·019; sulphur, 0·105. The sulphide of iron, detached very carefully from the mass, gave—Iron, 6·11; sulphur, 39·56. The stony minerals, freed as much as possible from iron and pyrites, contained—Portion soluble in acid, 60·88; insoluble, 39·12. The latter, disintegrated and analysed, gave, in 100 parts—Silica, 50·08; alumina, 4·11; protoxide of iron, 19·85; magnesia, 20·14; lime, 3·90. The analysis of the soluble portion, owing to the unavoidable presence of a little iron and pyrites, furnished results, on analysis, that showed it to be mostly olivine. The soluble and insoluble matter as a whole (freed from pyrites and nickeliferous iron) gave, in 100 parts—Silica, 45·90; protoxide of iron, 23·64; magnesia, 26·52; alumina, 1·73; lime, 2·31; soda, 0·51; potassa, 0·64; sulphur, 1·01; and small quantities (not estimated) of oxides of manganese and chrome, phosphorus, and lithia; the latter detected by means of the spectroscope.

Annales des Mines, No. 5, 1869.

This number contains:—

Critical and Theoretico-Practical Examination of the Heaton Process.—M. L. Gruner.

Some Newly-Discovered and Proposed Processes for the Manufacture of Pig-Iron, Wrought-Iron, and Steel.—M. L. Gruner.

Researches on the Use which can be made of the Offal and Residues of Manufacturing Processes for Agricultural Purposes.—MM. E. Nivoit and E. Létrange.—We regret that we can only quote the sectional titles of this very interesting and lengthy memoir, which is filled with valuable information and a large number of chemical analyses. Residues from glue works; residues from beet-root sugar works; residues from the retting and peeling of flax; residues from breweries; gas-works residues and refuse; refuse from wool; residues and refuse from tan-yards; tallow-melting refuse; sawdust and wood ashes; coal ash; some peculiar mineral ash (*cendres minérales*) from the Ardennes, and their application to mixing with liquid manure. In many instances, full directions have been given for the proper analysis and quantitative estimation of the materials spoken of.

Boring of Shafts by Kind-Chandron's Method at Escarpelle.—M. J. De Boisset.

NOTES AND QUERIES.

Refractive Power of Saline Solutions.—In Chemical News, vol. xiv., p. 156, there is a short note, from *Les Mondes*, "On the Refractive Power of Saline Solutions." Can any of your readers refer me to any recent English work or detailed note on the subject?—P.

Bavarian, Vienna, and Belgian Beers.—Messrs. Zacherl and Degelmeyer.—Munich holy father beer—Sp. gr., 103; alcohol, 4·9; extract, 13·0; carbonic acid, 0·08. Bock beer—Sp. gr., 1·02; alcohol, 8·9; extract, 8·5; carbonic acid, 0·08. Salvator beer—Sp. gr., 1·02; alcohol, 4·2; extract, 8·1; carbonic acid, 1·2. Vienna beer (old)—Sp. gr., 1·012; alcohol, 5·2; extract, 5·0; carbonic acid, 1·5. Vienna double beer—Sp. gr., 1·026; alcohol, 5·2; extract, 7·8; carbonic acid, 1·8. Lambiek, Bruxelles—Alcohol, 4·7; extract, 3·4. Other variety (same name)—Sp. gr., 1·004; alcohol, 5·5; extract, 3·4; carbonic acid, 2·0. Faro beer, Brussels—Sp. gr., 1·005; alcohol, 4·9; extract, 3·0; carbonic acid, 2·0. Brunswick momme—Sp. gr., 1·231; alcohol, 3·6; extract, 47·6; carbonic acid, 1·2. Beer brewed at Utrecht—Alcohol, in 100 parts by volume, 5·4; acetic acid, in 100 parts by volume, 0·016; lactic acid, in 100 parts by volume, 0·35; carbonic acid, in 100 parts by volume, 0·159; extract, in 100 parts by weight, 3·49; ash, in 100 parts by weight, 0·36; albumen, in 100 parts by volume (calculated for 15·5 N), 0·46. Beer from Middelburgh—Alcohol (by bulk), 4·95; albuminous compounds, 0·83; sugar, dextrine, and extract, 3·67; ash, 0·42; lactic acid, 0·26; acetic acid, 0·02; carbonic acid, 0·10.

MEETINGS FOR THE WEEK.

Monday, Feb. 28th.—Royal Geographical, 8.30
—— London Institution, 4.
Tuesday, March 1st.—Royal Institution, 3. Dr. Masters, on "Plant Life."
—— Institution of Civil Engineers, 8.
Wednesday, 2nd.—Society of Arts, 8.
—— Pharmaceutical, 8.
Thursday, 3rd.—Royal Institution, 3. Prof. Odling, "Chemistry."
—— London Institution, 7.30.
—— Royal, 8.30
—— Chemical, 8.
—— Royal Society Club, 6.
Friday, 4th.—Royal Institution, 8. Mr. Reed, "Iron-Built Ships."
—— Geologists' Association, 8.
Saturday, 5th.—Royal Institution, 3. Prof. Max Müller, "On the Science of Religion."

TO CORRESPONDENTS.

*** Vol. XX. of The Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

Kalium.—Perchloric acid is in very small demand. The demand for permanganate of potassium is considerable: Messrs. Condy and Co., Battersea, are the principal makers.

J. W. S. and others.—We shall be glad if you will forward replies for "Notes and Queries" in such a form that they can be printed in the Journal. We do not wish a query publicly made to be privately answered.

James Power.—A work on the subject by the Editor is in the press.

Professor Charles A. Cameron; Dr. A. W. Hofmann, F.R.S.; H. N. Draper; Dr. Moore; John Pattinson, F.C.S., are thanked for their communications, which shall receive early attention.

BOOKS RECEIVED.

General-Versammlung der Deutschen Chemischen Gesellschaft zu Berlin am December 11th, 1869. From Dr. A. W. Hofmann, F.R.S.

Annual Report of the Progress of Pharmacy.

Transactions of the Newcastle Chemical Society.

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THE CHEMICAL NEWS.

VOL. XXI. No. 536.

ON THE ESTIMATION OF THREE KINDS OF SUGAR IN ONE SOLUTION.

By A. DUPRE, Ph.D.,
Lecturer on Chemistry at Westminster Hospital.

FOR some years past, I have been constantly in the habit of estimating two, and sometimes three, kinds of sugar present in one solution, by the conjoint use of the chemical and optical methods. The plan adopted by me differs from that of Professor Apjohn described in the CHEMICAL NEWS (vol. xxi., p. 86), and, I believe, solves the same problem in a more direct manner. This problem is the estimation of cane, grape, and fruit sugar, when present in the same solution. Invert-sugar is a mixture, or compound, of fruit and grape sugar in equivalent proportions, and its amount can therefore readily be calculated if the amount of these two sugars be known.

Now, cane-sugar does not reduce the cupric solution, and is not affected by heating with a dilute solution of caustic alkali. Both grape and fruit sugar, however, reduce the cupric solution, and both are readily destroyed by being heated with a solution of caustic alkali. We can thus estimate the amount of cane-sugar, by its rotative power, having previously destroyed the grape and fruit sugar; we can estimate, chemically, the aggregate amount of these last two sugars, quite independently of the presence or absence of cane-sugar. We have now only to estimate the amount of rotation due to the three sugars jointly, and are then in possession of all the necessary data for the quantitative estimation of each.

It will be seen that the cane-sugar is estimated by direct observation; and the problem thus, in reality, resolves itself into the estimation of a mixture of grape and fruit sugar. The amount of rotation produced by these two being estimated directly, if cane-sugar be absent; indirectly, in the presence of cane-sugar, by subtracting the rotation due to the cane-sugar from the rotation produced by the three sugars jointly.

The instrument employed by me (one of Professor Jellet's beautiful saccharometers) has a 10-inch tube, in which a solution containing—

1 per cent cane-sugar, required for compensation 0·2418 inches left-handed turpentine.

1 per cent fruit-sugar, required for compensation 1·502 inches of a 10 per cent cane-sugar solution.

1 per cent grape-sugar,* was equivalent to 0·836 inches of 10 per cent cane-sugar solution.

Now, let x be the amount of fruit-sugar sought; let y be the amount of grape-sugar sought; let p be the sum of both sugars found by the cupric solution expressed in percentages; and let a be the number of inches of 10 per cent cane-sugar solution which has been found to compensate, or be equivalent in rotating power to, the mixture p of fruit and grape sugar present.

We have then the equations—

$$x+y=p$$

$$x\times 1{\cdot}502-y\times 0{\cdot}836=\pm a$$

and

$$x=\frac{p\times 0{\cdot}836\pm a}{2{\cdot}338}$$

$$y=p-x$$

As regards a, the sign + is taken if the mixture of the two sugars turns to the left, and requires to be compensated by the cane-sugar solution; the sign −, if the mixture turns to the right; in which case a represents the number of inches of 10 per cent cane-sugar solution equal in rotative power to this mixture, as estimated by the left-handed turpentine, calculated, of course, in either case, for the 10-inch tube.

I have employed the foregoing method only for estimating the amounts of these three sugars present in wines, but it is, no doubt, equally applicable to crude sugars and syrups.

* I have throughout taken grape-sugar dried at 100°, when its composition is $C_6H_{12}O_6$, the same as fruit-sugar.

THE WATER-TYPE.

By J. ALFRED WANKLYN.

THE following propositions are, I believe, admitted generally at the present time:—

(1). That the oxy-salts of the metals are built on the water-type, and consist of acid-forming radical and metal, bound together by one or more atoms of oxygen.

(2). That an acid is a salt wherein hydrogen plays the part of the metal, being bound by means of oxygen to an acid-forming radical; and that, in like manner, an alkali is a structure wherein hydrogen is bound by oxygen to a metal.

(3). That double decompositions between salts, or between salts and acids or alkalies, or between acids and alkalies, consist in exchanges of one metal for another metal, or for hydrogen. Thus the double decomposition between sulphate of potash and nitrate of baryta is commonly regarded as consisting in an exchange of potassium for barium, whereby sulphate of baryta and nitrate of potash are produced. The same result may be conceived as being produced by the exchange of sulphuryl for nitroxyl $(NO_2)_2$; but chemists do not usually refer these double decompositions to displacements of the acid-forming radicals. The nomenclature which is in use favours the one mode of representation and discourages the other. Thus, keeping to the example above given, chemists of the present day write sulphate of potassium, or potassic sulphate or potassium sulphate and nitrate of barium, baric nitrate or barium nitrate; names which suggest the view that double decomposition takes place by exchange of the metals. The terms potassate of sulphuryl and bariumate of nitroxyl (names which would point to exchange of acid-forming radicals as the *modus operandi* of double decomposition) have, so far as I know, never been proposed by anyone.

As may be gathered from his recent papers, the author of the present notice is prepared to offer other modes of representation, in place of those which have just been set forth, and which are in vogue at the present time.

Instead of looking upon the oxy-salts of the metals as consisting of acid-forming radical and metal held together by oxygen, it is proposed to consider them as being structures wherein oxygen and acid-forming radical are held together by the metal. Thus, quoting from a former paper, acetate of soda is regarded as the following:—

$$Na'''\begin{Bmatrix}O''\\(C_2H_3O)'\end{Bmatrix}$$

And it should be understood that the considerations which have been urged for the metal sodium and its compounds are taken as being of extensive application, and, with slight modifications, as applicable to the metals in general.

The analogy between acids and metallic salts the author of this notice denies. That the acids are built on the water-type he is, indeed, not prepared to deny; but he maintains that the acids and the metallic salts are built on totally different types. The alkalies, instead of being

waters and being like the acids in structure, are like metallic salts. Thus caustic soda is—

$$Na''' \begin{cases} O'' \\ H \end{cases}$$

Double decompositions between metallic salts, or between salts and acids or alkalies, or between acids and alkalies, are exchanges of one acid-forming radical for another, or for hydrogen. Such, then, is the contrast between that which is generally received by chemists and that which is proposed as a substitute for it.

These opposite modes of representation are, as a little reflection will show, embodiments of fundamental notions respecting the analogy, or want of analogy, between hydrogen and metals.

The one which is generally in vogue expresses resemblance between hydrogen and metals.

The other, which is proposed, expresses dissimilarity between hydrogen and metals.

Is there, then, as a matter of fact, fundamental analogy, or fundamental want of analogy between hydrogen and metals?

In endeavouring to arrive at a just conclusion on this point, it will hardly be proper to omit mentioning the very obvious facts of the extreme physical dissimilarity of hydrogen to the metals. Whilst hydrogen is the lightest known gas (not liquefied by any degree of cold or of pressure hitherto applied to it), there are metals which figure as the heaviest known solids, and there are metals which have hardly been fused; and all, save one, are solids, under ordinary conditions. There is, moreover, a total want of continuity of physical properties between hydrogen and metals. In volatility, the metal next to hydrogen is mercury; but there is an immense gap between a substance which has not been liquefied and a substance which, like mercury, only ceases to be liquid at 360° C.

The extreme eagerness with which chemists seize upon the faintest shadow as a pretext for assigning to hydrogen the faculty of existing in a condensed state is, to my mind, evidence of the great importance instinctively allowed to the vast physical dissimilarity between hydrogen and metals which are next of kin to hydrogen according to popular chemical belief.

The facts of the vapour-densities of hydrogen-compounds, and of such metallic compounds as have been investigated in this direction, reiterate the same tale of dissimilarity.

In the standard two volumes of hydrochloric acid gas, there exists only one volume of chlorine; but, in the standard two volumes of chloride of mercury vapour, or chloride of aluminium, or chloride of iron, there are more than one volume of chlorine. The vapour-densities of organo-metallic bodies, moreover, all exhibit more than one volume of organic radical in the standard two volumes of vapour. Up to the present time, no metallic compound has been found to exhibit a vapour-density which should entitle it to figure as a representative of hydrochloric acid gas.

These facts have already exercised a part of their legitimate sway over the theories of metallic structures admitted by the generality of chemists. The old *exact* parallels between salts of hydrogen and salts of metals is no longer maintained in its integrity. Between the formulæ for acetic acid and acetate of zinc we no longer see the ancient all-but-identity.

They used to be*—

$$\begin{matrix} C_2H_3O \\ H \end{matrix}\Big\}O \qquad \begin{matrix} C_2H_3O \\ Zn \end{matrix}\Big\}O$$

They are to-day—

$$\begin{matrix} C_2H_3O \\ H \end{matrix}\Big\}O \qquad \begin{matrix} (C_2H_3O)_2 \\ Zn'' \end{matrix}\Big\}O_2$$

* Ten years ago, in commenting on the vapour-densities of metallic compounds, I employed the phrase—Zinc and mercury, regarded as to the densities of their compounds, are to be looked upon as representatives, not of hydrogen, but of oxygen. My own views respecting the structure of zinc compounds have, it is true, undergone development since that time, but still, the train of thought which dictated the phrase is in accordance with my present convictions on the subject.

And, in making proposals for sweeping changes in the notation of metallic compounds, I have not to confront a simple and uniform body of notation, but, on the contrary, the confused and, in many respects, arbitrarily-complex formulæ which are strewed through that deluge of modern text-books of chemistry which has flooded the scientific press.

A comparison of the chemical characters of hydrogen compounds with those of metallic compounds will next be instituted.

One of the chief arguments in support of analogy between hydrogen and metals may be stated as follows:—

For every acid (which is a salt of hydrogen), there exists a whole series of metallic derivatives (salts of the metals); and the properties of salts present a graduated series, in which series the properties of the hydrogen term (or acid) constitute a sort of natural first-term.

In criticism, it may be urged that, although there cannot be an acid and no corresponding salts (for the definitional reason that we require salts in order to recognise the claim to be regarded as an acid), still the converse does not hold good. We do know salts the acids corresponding to which are non-existent, or, at any rate, have hitherto resisted all attempts to prepare them. Moreover, the case of exceeding stability in the metallic salts, and exceeding fragility in the acid, is of frequent occurrence. One of the most familiar maxims in the practical management of chemical operations is that there is a world of difference between that kind of chemical action which takes place in neutral or alkaline solutions and that which happens in presence of free acid. Solution of chromic acid is an oxidising agent of great potency. Solutions of chromates of the metals are almost destitute of oxidising power. These differences between the properties of the acid and the properties of its salts lead on to the discussion of the question of the series of salts with the so-called salt of hydrogen for its initial term.

The sulphates, for example. Water typists tell us that sulphate of potash is inert, because potassium is so strongly electro-positive as to balance the strongly electro-negative sulphuryl which is bound to it by the intervention of oxygen. Sulphuric acid is energetic, because hydrogen is not sufficiently electro-positive to counterpoise the sulphuryl.

But the water typists fail to explain how it comes to pass that sulphate of silver is not energetic; for, since silver is unquestionably less electro-positive than hydrogen, the silver-salt should be even less balanced than the hydrogen-salt.

Bearing in mind that the electro-chemical place of hydrogen is, in reality, an intermediate one, hydrogen, being more electro-positive than some metals, and less so than others, it is difficult to see on what principle the so-called salt of hydrogen can be made to occupy the first place in the saline series. Obviously, it would not do to range in series according to volatility. (Mercury comes next to hydrogen in volatility, and yet mercury-salts are not particularly like acids). Neither could an arrangement according to magnitude of atomic weight be attempted; for the properties of salts are obviously not related to the atomic weights of the metals.

In short, though there are gradations of properties among the metallic salts, these gradations are broken in arriving at the so-called salts of hydrogen; and, in addition to those broad and obvious distinctions between acids and salts which have arrested the attention of chemists ever since chemistry began to be cultivated, there is a fundamental dissimilarity that is at least as broad as that which lies on the surface of the subject.

Recurring to the statement of the water typists that, for every acid, there exists a whole series of metallic derivatives, I have to remark that this should be carefully distinguished from another statement, viz.:—"For every atom of hydroxyl in a compound, an equivalent of *metaloxyl* may be substituted." This latter statement is especially far removed from the truth. By far the greater

part of the hydroxyl, the existence of which is recognised by chemists, is incapable of undergoing even pseudo-replacement by most kinds of metaloxyl. I need hardly refer particularly to the now well-known distinction in organic chemistry between such hydroxyl the hydrogen of which is recognised as being easily replaceable by metals, and such as does not admit of such replacement.

It will not be necessary to do more than allude to the fact that the vast array of compounds of carbon with hydrogen is unrepresented by corresponding compounds of carbon with metals. When zinc was made to unite with ethyl, there did not result a representative of ethyl-hydride, but a representative of ethyl-oxide, which is double. When sodium was made to combine with ethyl, it dragged along with it zinc in union with ethyl, and furnished a representative, not of ethyl-hydride, but of ammonia.

From the foregoing, it appears that there is the utmost fundamental dissimilarity between hydrogen and metals. On a future occasion, I propose to develop the new notation of metallic compounds.

London, Feb. 21st, 1870.

A NEW THEORY OF THE CONSTITUTION OF METALLIC COMPOUNDS.

By J. ALFRED WANKLYN.

In most recent manuals of chemistry, whilst nitrate of potash is written KNO_3, nitrate of baryta is written $Ba''N_2O_6$; nitrate of zinc, $Zn''N_2O_6$, &c. In short, whilst the salts of the alkalies and of silver figure as if they were like salts of ethyl, the salts of barium, calcium, magnesium, mercury, zinc, &c., are made to resemble, in formula, the salts of ethylene. Such being the case, it might be expected that the characteristics of distinguishing alcohol compounds from glycol compounds should be presented by the two classes of metallic salts—for instance, the property of forming a fully-saturated and a half-saturated salt might be looked for in barium compounds. We know, however, of no half-nitrate or half-acetate of baryta; and, speaking generally, although the adoption of the two orders of formula for the two classes of metals is an assertion that monobasic acids form only one salt with an alkali-metal or with silver, and two salts with every such metal as barium, yet chemists do not know that such is the case (as a matter of experiment).

That the present glycol-formulæ for the compounds of barium, calcium, magnesium, &c., should have come into general use, and that there should be next to no experimental support for these formulæ, is a most extraordinary thing, and speaks volumes for the depressed state of our chemical conservatives.

The reasons for the adoption of glycol formulæ in the instance of certain metals were partly some very doubtful deductions drawn from the specific heat of the metals, and mainly considerations of the vapour-density of certain metallic compounds.

The facts ascertained concerning the vapour-densities of metallic substances are as follows:—

If the atomic weight of mercury be calculated from the vapour-density of metallic mercury, we arrive at the number 100 for the atomic weight of the metal. In like manner, calculating from the vapour-density of metallic zinc, we get 32·5 for the atomic weight of the metal. But, if, instead of operating upon the metal, we take the chloride or the ethyl-compound, and deduce the atomic weights from the vapour-densities of those compounds, we get 200 for mercury and 65 for zinc. In presence of this discrepancy, chemists have elected to receive the values obtained from the chlorides or ethyl-compounds, and to reject those from the free metals. This procedure involves rather startling theoretical consequences. Chemists maintain that oxygen, hydrogen, nitrogen, chlorine, bromine, and iodine, when existing in the free state, exist in the form of molecules, each molecule being formed of two atoms. Chemists maintain, also, that free sulphur, or free phosphorus, or free arsenic exists in the state of molecules, whereof each molecule contains more than two atoms of the element; and, along with all this, chemists maintain that metallic mercury or zinc consists of molecules, whereof each molecule contains only *one* atom of the element. If so vital a distinction existed between the constitution of a free metal and a free metalloid, we ought to find a stupendous difference in chemical or physical properties accompanying these differences in structure. There is, however, nothing very special about metallic mercury or metallic zinc—nothing that should lead to the adoption of extraordinary formulæ for them.

In the new system of notation which I propose, I take the molecule of zinc and of mercury as consisting of two atoms, just as in the case of oxygen, hydrogen, nitrogen, or chlorine; and I take the great density of the vapours of chloride of mercury and zinc-ethyl as proving that these compounds belong to the second rank of mercurial or zinc compounds. The new notation, as a consequence of this mode of treatment, does not require that potash, barium, and zinc salts should be written on radically different types, but restores to the chemistry of the metals much of the simplicity which has been so recently lost.

In two papers published in the CHEMICAL NEWS (vol. xx., pp. 293, 313), I gave the new formulæ for the compounds of sodium. I now give the new formulæ for the compounds of zinc—

$Zn''' = 32{\cdot}5$

Free zinc .. .. .. $Zn'''.Zn'''$

Oxide of zinc .. .. $Zn'''\left\{\begin{matrix}O\\—\\—\end{matrix}\right\}Zn'''$

Hydrated oxide of zinc $Zn'''\left\{\begin{matrix}O''\\H\end{matrix}\right.$

Nitrate of zinc .. .. $Zn'''\left\{\begin{matrix}O''\\NO_2\end{matrix}\right.$

Acetate of zinc .. .. $Zn'''\left\{\begin{matrix}O''\\(C_2H_3O)'\end{matrix}\right.$

Sulphate of zinc.. .. $Zn'''\left\{\begin{matrix}O'' & O''\\—SO_2—\end{matrix}\right\}Zn'''$

Chloride of zinc .. .. $Zn'''\left\{\begin{matrix}Cl\ Cl\\—\\—\end{matrix}\right\}Zn'''$

Zinc-ethyl .. .. .. $Zn'''\left\{\begin{matrix}C_2H_5\ C_2H_5\\—\\—\end{matrix}\right\}Zn'''$

Hydrochlorate of zinc $Zn'''\left\{\begin{matrix}OH\\Cl\\H\end{matrix}\right.$

The double compound of zinc-ethyl and sodium-ethyl I write—

$$Na'''\left\{\begin{matrix}(Zn_2)''C_2H_5\\C_2H_5\\C_2H_5\end{matrix}\right.$$

From the foregoing, and from these examples, and from those given in my two papers which appeared in the CHEMICAL NEWS (vol. xx., pp. 293, 313), it will be perceived that I propose to write the compounds of the so-called "diatomic metals" in the same way as the compounds of the so-called monatomic metals, and that, in fact, I deny that any metal is diatomic. Into the same great class I put potassium, sodium, lithium, cæsium, rubidium, thallium, barium, strontium, calcium, magnesium, zinc, cadmium, mercury, manganese, bismuth, antimony, arsenic, phosphorus, nitrogen, and some others. This is the 3, 5, 7 atomic class.

Into class 2 is put tin, iron, aluminium, chromium, and some others. Class 2 is 4-atomic.

All the metals fall into one or other of these two classes.

Some of the principles embodied in the new mode of notation are:—

That the metals are fundamentally unlike hydrogen, and that they are eminently polyatomic.

That, most commonly, the metallic chlorides and ethyl-compounds are more complicated in structure than very many other compounds of the metal.

That the hydrated chloride is usually a definite compound.

That double decompositions take place by exchange of the acid-forming radicals of two salts.

On a future occasion, I propose to give examples of the new notation.

London, February 26th, 1870.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 63).

Lesson I. On the Use of the Condensing Lens and Mirror.

Material for Examination—White Blotting-Paper.

Arrange the microscope at a comfortable inclination, and adjust the draw-tubes of the eye-pieces to suit the distance between the eyes. Screw on the objective, O1; in doing this, hold the glass within the nozzle of the microscope with the first and second fingers of the left hand, while it is screwed in with the finger and thumb of the right. Do not leave go with the left hand until the screws have good hold; observe the same precaution in unscrewing; never risk the fall of an object-glass.

Tear with the forceps (not cut) a minute fragment from the edge of a piece of blotting-paper; place it upon the glass stage-plate, and bring it, as nearly as can be judged, under the centre of the object-glass, which should be well raised above the stage. Place the lamp on the left of the microscope, at a height about half way between the stage and eye-piece, and direct the light upon the paper with the condensing lens (vol. xx., p. 159). Bring the object-glass down, by means of the coarse adjustment, nearly to the working distance of the objective; this is always considerably shorter than the nominal focal length; with O1 it may be a little more than half an inch. After a little practice, the student will learn the proper distance for each glass; until this is acquired, it is best to proceed cautiously, to avoid injury to the object, especially when high powers are used.

Now look through the instrument; adjust the position of the object, with the fingers or stage movements, until it occupies the centre of the field; bring it accurately into focus with the coarse adjustment; and alter the position of the condensing lens and of the lamp, if necessary, so as to obtain the most perfect illumination.

The paper will be found to consist of interlaced fibres, which are seen to the best advantage at the edges, where they are frayed out: hence the direction to tear. This applies in numerous cases, a laceration or fracture sometimes revealing points of structure in a manner not easily demonstrated by other means.

When the object has been fully examined, remove the condenser, open the large aperture in the wheel of diaphragms beneath the stage, lower the lamp upon its stem into a convenient position for lighting the concave mirror, and direct the convergent pencil upon the object. It will be found that the view now obtained is in every respect inferior to that by reflected light; this is owing, partly to the opacity of the paper, and partly to the different densities of the object and of the medium in which it is viewed. If a higher power, O½,M, is used, the result will be much worse; this kind of view is that obtained by beginners, who usually try to examine every object by transmitted light, and but rarely use other and better means of illumination. Change the power to O1, B; place a drop of water on the object with a pipette (or the tip of the finger); cover with a thin glass; absorb any surplus moisture with blotting-paper; replace the slide on the stage; and adjust the focus. The confused appearance of the edges has now disappeared, and the light to some extent penetrates the central portions of the object. With the binocular, the full light from the mirror will be found to produce an unpleasant glare, and the white cloud illumination (vol. xx., p. 265) may be substituted with advantage. Still, little beyond the fibres at and near the edges can be well made out. Remove the slide from the stage; take off the cover, and with a pair of mounted needles tear up and spread out the moistened paper; replace the cover, and examine as before. All the structure will now, probably, be seen; if not, tear the object up still more, until the result is satisfactory. Higher powers may now be used with advantage, taking care to make the requisite correction for the aberration caused by the cover-glass (vol. xx., p. 169), should the objective be provided with the proper adjustment. With the glasses O¼, O½, and higher powers, it will be desirable to employ the fine adjustment in completing the focussing, and during the observation. Until the beginner has had some experience, it will be best to use O½, in preference to a higher power, as the risk of damaging the object, or object-glass, is lessened; after a time, the use of glasses of short working distance will become easy. In removing a slide from the stage when a high power is employed, raise the body to some distance, to prevent accidental contact with the front lens, as it might be scratched or otherwise injured.

Try the effect of viewing some more torn up fragments in other media, such as oil, turpentine, or glycerine. Mount a specimen in balsam (vol. xx., p. 207), taking care that the paper has been well saturated with turpentine, to remove air bubbles.

These experiments may be repeated with other kinds of paper, and their different degrees of compactness noticed. The determination of the material of which the paper is composed had better be deferred until Lesson VI. has been studied.

Arrange the microscope and lamp for the use of the condensing lens; as before, use O1, B; make a few marks, with a soft black-lead pencil, on a piece of blotting-paper, and notice the disposition of the particles of plumbago among the fibres. Examine ink marks; printing from plate (a visiting card will do); likewise specimens of surface-printing, as wood engraving or type, and also lithographs. Notice the varying manner in which the ink is distributed.

Repeat the experiments with the light on the right hand, and also in front. Although it is most convenient to place the lamp on the left, because it is out of the way of the right hand moving and adjust-

ing the object in the stage, yet it may sometimes be required to place the light elsewhere; and the student should be able to work with it in any situation. Practice by daylight should not be neglected whenever opportunities offer.

Try, also, the effect of using different eye-pieces. When a complete series of objectives is not at hand, an awkward interval of magnifying power may often be thus filled up (see Tables, vol. xxi., p. 89). In drawing, it is often useful to make the object fill the field; this can generally be done by a suitable change of eye-piece.

(To be continued.)

ON THE

CONTINUITY OF THE GASEOUS AND LIQUID STATES OF MATTER.*

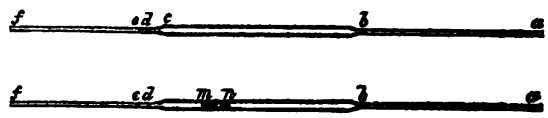
By THOMAS ANDREWS, M.D., F.R.S.,
Vice-President of Queen's College, Belfast.

In 1822 M. Cagniard de la Tour observed that certain liquids, such as ether, alcohol, and water, when heated in hermetically sealed glass tubes, became apparently reduced to vapour in a space from twice to four times the original volume of the liquid. He also made a few numerical determinations of the pressures exerted in these experiments. In the following year Faraday succeeded in liquefying, by the aid of pressure alone, chlorine and several other bodies known before only in the gaseous form. A few years later Thilorier obtained solid carbonic acid, and observed that the coefficient of expansion of the liquid for heat is greater than that of any aëriform body. A second memoir by Faraday, published in 1826, greatly extended our knowledge of the effects of cold and pressure on gases. Regnault has examined with care the absolute change of volume in a few gases when exposed to a pressure of twenty atmospheres, and Pouillet has made some observations on the same subject. The experiments of Natterer have carried this inquiry to the enormous pressure of 2790 atmospheres; and although his method is not altogether free from objection, the results he obtained are valuable and deserve more attention than they have hitherto received.

In 1861 a brief notice appeared of some of my early experiments in this direction. Oxygen, hydrogen, nitrogen, carbonic oxide, and nitric oxide were submitted to greater pressures than had previously been attained in glass tubes, and while under these pressures they were exposed to the cold of the carbonic acid and ether-bath. None of the gases exhibited any appearance of liquefaction, although reduced to less than 1-500th of their ordinary volume by the combined action of cold and pressure. In the third edition of Miller's "Chemical Physics," published in 1863, a short account, derived from a private letter addressed by me to Dr. Miller, appeared of some new results I had obtained, under certain fixed conditions of pressure and temperature, with carbonic acid. As these results constitute the foundation of the present investigation and have never been published in a separate form, I may, perhaps, be permitted to make the following extract from my original communication to Dr. Miller. "On partially liquefying carbonic acid by pressure alone, and gradually raising at the same time the temperature to 88° F., the surface of demarcation between the liquid and gas became fainter, lost its curvature, and at last disappeared. The space was then occupied by a homogeneous fluid, which exhibited, when the pressure was suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass. At temperatures above 88° no apparent liquefaction of carbonic acid, or separation into two distinct forms of matter, could be effected, even when a pressure of 300 or 400 atmospheres was applied. Nitrous oxide gave analogous results."*

In the following experiments the gas to be compressed is introduced into a tube, *f*, *a* (Fig 1), having a capillary bore from *a* to *b*, a diameter of about 2·5 m.m. from *b* to *c*, and of 1·25 m.m. from *c* to *f*. The gas carefully dried is passed for several hours through the tube open at both ends, as represented below. The presence of a column of water

FIG. 1.



of two metres in height was necessary to maintain a moderate stream of gas through the fine capillary tube. In the case of carbonic acid, the gas, after passing through the apparatus, was made to bubble by means of a connecting tube through mercury, and a portion was collected from time to time, in order to ascertain its purity. The current was continued till the residual air, after the action of caustic potash, was reduced to a constant minimum. In repeated trials I found that in the complicated arrangements I had to adopt, the residual air could not be reduced to less than from 1-500th to 1-1000th of the entire volume of the carbonic acid. Even after continuing the current for twenty-four hours this residue appeared; and in discussing some of the results obtained by exposing the gas to high pressures, the presence of this small quantity of air must be carefully taken into account. The capillary end at *a* was then sealed, and the other end was also closed, and afterwards introduced under a surface of pure mercury contained in a glass capsule. The lower end, while under the surface of the mercury, was opened, and heat applied so as to expel a little of the gas. On cooling, contraction occurred, and a short column of mercury entered. The capsule and lower end of the tube were then placed under the receiver of an air-pump, and a partial vacuum was formed till about one-fourth of the gas was removed. On restoring the pressure, a column of mercury entered and occupied the place of the expelled gas. By withdrawing the end of the tube from below the surface of the mercury in the capsule, and again exhausting cautiously, the column of mercury should be reduced to any required length. The tube, when thus filled, had the form shown in Fig. 1.

Two file-marks had been made, one at *d*, the other at *e*, in the narrow part of the tube, about 10 m.m. distant from each other, and the capacity of the tube from a mark near *a* to *d*, and also from the same mark to *e*, had been determined by filling it with mercury at a known temperature and weighing the mercury. The tube was now placed accurately in a horizontal position and connected by an air-tight junction with one limb of a long U-tube filled with mercury. Each limb of the U-tube was 600 m.m. long, and 11 m.m. in diameter. By removing mercury from the outer limb of the U-tube, a partial vacuum was obtained, and the column of mercury, *m*, *n*, was drawn into the narrow tube, *d*, *f*. From the difference of capacity of this part of the tube, the column of mercury was now about four times longer than before. It was easy with a little care so to adjust the pressure that the inner end of the mercurial column coincided with the mark *e*. When this was accomplished, the difference of level of the mercury in the two limbs of the U-tube was accurately read by means of a cathetometer, and the height of the barometer as well as the temperature were carefully noted. Similar observations were made with the gas expanded to the mark *d*. Two independent sets

* The Bakerian Lecture for 1869, delivered before the Royal Society. Communicated to the CHEMICAL NEWS, and revised by the author.

* Miller's "Chemical Physics," 3rd edition, p. 328.

of data were thus obtained for calculating the volume of the gas at 0° C. and 760 m.m., and the results usually agreed to less than 1-1000 part. The tube, after being disconnected with the U-tube, was cut across a little beyond *e*, and was now ready to be introduced into the pressure apparatus.

The capillary tubes were calibrated with great care, and their mean capacity was determined by weighing a column of mercury whose length and position in the tube were accurately observed. One m.m. of the air-tube used in these experiments had an average capacity of 0·00002477 c.c., and 1 m.m. of the carbonic-acid tube of 0·00003376 c.c. A table was constructed showing the corrected capacity of each capillary tube from the sealed end for every m.m. of its length. An allowance of 0·5 m.m. was made for the cone formed in sealing the tube.

For the sake of clearness I have described these operations as if they were performed in the detached tube. In actual practice, the tube was in the brass end-piece before it was filled with gas.

The construction of the apparatus employed in these experiments will be readily understood from Fig. 2, which

FIG. 2.

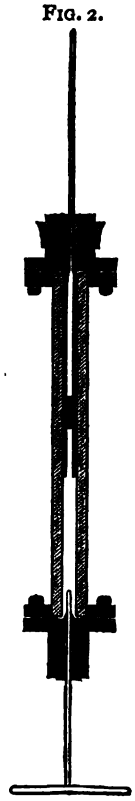
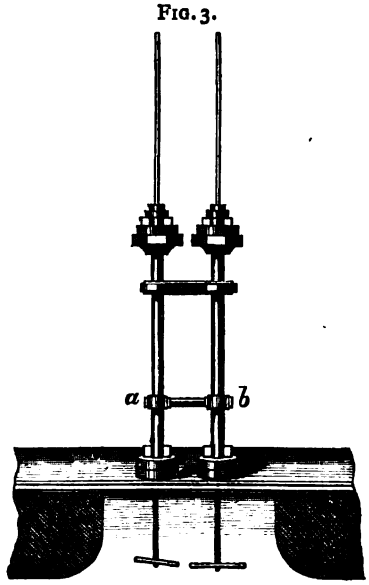


FIG. 3.



exhibits a section of the simple form. Two massive brass flanges are firmly attached round the ends of a cold-drawn copper tube of great strength, and by means of these flanges two brass end-pieces can be securely bolted to the ends of the copper tube, and the connections made air-tight by the insertion of leather washers. The lower end-piece carries a steel screw, 180 m.m. long, 4 m.m. in diameter, and with an interval of 0·5 m.m. between each thread. The screw is packed with care, and readily holds a pressure of 400 atmospheres or more. A similar end-piece attached to the upper flange carries the glass tube containing the gas to be compressed. The apparatus, before being screwed up, is filled with water, and the pressure is obtained by screwing the steel screw into the water.

In the compound apparatus (Fig. 3) the internal arrangements are the same as in the simple form. A communication is established between the two sides of the apparatus through *a*, *b*. It is indifferent which of the steel screws below is turned, as the pressure is immediately diffused through the interior of both copper tubes, and is applied through the movable columns of mercury to the two gases to be compressed. Two screws are employed for the purpose of giving a greater command of pressure. In the figure the apparatus is represented without any accessories; when in use it is provided with arrangements for maintaining the capillary tubes and body of the apparatus itself at fixed temperatures. A rectangular brass case, closed before and behind with plate glass, surrounds each capillary tube, and allows it to be maintained at any required temperature by the flow of a stream of water. The body of the apparatus itself, is enclosed in an external vessel of copper, which is filled with water at the temperature of the apartment. This latter arrangement is essential when accurate observations are made.*

The temperature of the water surrounding the air tube was made to coincide, as closely as possible, with that of the apartment, while the temperature of the water surrounding the carbonic acid tube varied in different experiments from 13° C. to 48° C. In the experiments to be described in this communication, the mercury did not come into view in the capillary part of the air-tube till the pressure amounted to about forty atmospheres. The volumes of the air and of the carbonic acid were carefully read by a cathetometer, and the results could be relied on with certainty to less than 0·05 m.m. The temperature of the water around the carbonic-acid tube was ascertained by a thermometer carefully graduated by myself according to an arbitrary scale. This thermometer was one of a set of four, which I constructed some years ago, and which all agreed so closely in their indications, that the differences were found to be altogether insignificant when their readings were reduced to degrees.

The general form of the curves representing the changes of volume in carbonic acid will hardly undergo any sensible change from the irregularities in the air-tube; nor will any of the general conclusions at which I have arrived be affected by them. It must, however, always be understood that when the pressures are occasionally spoken of as indicated by the apparent contraction of the air in the air-gauge, the approximate pressures only are meant.

To obtain the capacity in cubic centimetres from the weight in grammes of the mercury which filled any part of a glass tube, the following formula was used,

$$C = W.\frac{1+0{\cdot}000154.t}{13{\cdot}596}.1{\cdot}00012,$$

where C is the capacity in c.c., W the weight of the mercury which filled the tube at the temperature t, 0·000154 the coefficient of apparent expansion of mercury in glass, 13·596 the density of mercury at 0°, and 1·00012 the density of water at 4°

The volume of the gas V, at 0° and 760 m.m. of pressure, was deduced from the double observations, as follows.

$$V = C.\frac{1}{1+at}.\frac{h-d}{760}$$

where C is the capacity of the tube (Fig. 1) from *a* to *d*, or from *a* to *e*, t the temperature, a the coefficient of expansion of the gas for heat (0·00366 in the case of air, 0·0037 in that of carbonic acid), h the height of the barometer reduced to 0° and to the latitude of 45°, d the difference of the mercurial columns in the U-tube similarly reduced.

Having thus ascertained the volumes of the air and of the carbonic acid before compression, at 0° and 760 m.m., it was easy to calculate their volumes under the same

* In the original memoir a figure is given representing the apparatus with all these accessories.

pressure of 760 m.m., at the temperatures at which the measurements were made when the gases were compressed, and thence to deduce the values of the fractions representing the diminution of volume. But the fractions thus obtained would not give results directly comparable for air and carbonic acid. Although the capillary glass tubes in the apparatus communicated with the same reservoir, the pressure on the contained gases was not quite equal, in consequence of the mercurial columns, which confined the air and carbonic acid, being of different heights. The column always stood higher in the carbonic-acid tube than in the air tube, so that the pressure in the latter was a little greater than in the former. The difference in the lengths of the mercurial columns rarely exceeded 200 m.m., or about one-fourth of an atmosphere. This correction was always applied, as was also a trifling correction of 7 m.m. for a difference of capillary depression in the two tubes.

In order to show more clearly the methods of reduction, I will give the details of one experiment.

Volume of air at 0° and 760 m.m. calculated from the observations when the air was expanded to *a e*, 0·3124 c.c.

Volume of same air calculated from the observations when the air was expanded to *a d*, 0·3122 c.c.

Mean volume of air at 0° and 760 m.m., 0·3123 c.c.

The volumes of the carbonic acid, deduced in like manner from two independent observations, were 0·3096 c.c. and 0.3094 c.c. Mean, 0·3095 c.c.

The length of the column of air, after compression at 10·76° in the capillary air-tube, was 272·9 m.m., corresponding to 0·006757 c.c. Hence we have—

$$\delta' = \frac{0{\cdot}006757}{0{\cdot}3123 \times 1{\cdot}0394} = \frac{1}{48{\cdot}04}$$

But, as the difference in the heights of the mercurial columns in the air-tube and carbonic acid tube, after allowing for the difference of capillary depression was 178 m.m., this result requires a further correction—$\frac{178}{760}$ of an atmosphere—in order to render it comparable with the compression in the carbonic acid tube. The final value for δ (the fraction representing the ratio of the volume of the compressed air at the temperature of the experiment to its volume at the same temperature and under the pressure of one atmosphere) will be—

$$\delta = \frac{1}{47{\cdot}81}$$

The corresponding length of the carbonic acid at 13·22°, in its capillary tube, was 124·6 m.m., equivalent to 0·004211 c.c., from which we deduce for the corresponding fraction for the carbonic acid—

$$\epsilon = \frac{0{\cdot}004211}{0{\cdot}3095 \times 1{\cdot}0489} = \frac{1}{77{\cdot}09}$$

Hence, it follows that the same pressure which reduced a given volume of air at 10·76° to $\frac{1}{47{\cdot}81}$ of its volume, at the same temperature, under one atmosphere, reduced carbonic acid at 13·22° to $\frac{1}{77{\cdot}09}$ of its volume, at the temperature of 13·22°, and under a pressure of one atmosphere. Or, assuming the compression of the air to be approximately a measure of the pressure, we may state that, under a pressure of about 47·8 atmospheres, carbonic acid, at 13·22°, contracts to $\frac{1}{77{\cdot}09}$ of its volume under one atmosphere.

(To be continued.)

NOTE ON THE ACTION OF IODINE ON HYPOSULPHITE.*

By C. R. A. WRIGHT, B.Sc., F.C.S.

IN a paper on the valuation of manganese ores, read before the Newcastle Chemical Society, on November 25th, 1869, Messrs. Sherer and Rumpf state that they find it necessary to titrate the iodine solution obtained by Bunsen's process with standard hyposulphite solution "as soon as possible after the decomposition, since the solution, in presence of air, gradually reacts on the iodide of potassium and liberates iodine;" the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62·7 per cent of available peroxide in the manganese ore assayed when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours; Fresenius and Will's process giving, with the same sample, the intermediate number, 63·5 per cent.

In order to see how far this discrepancy might be accounted for by a possible irregularity in the action of iodine on hyposulphite under different circumstances, as to temperature, &c., a solution of iodine in potassium iodide was prepared of the strength of 5 grms. free iodine to the litre; a solution of pure re-crystallised sodium hyposulphite was also prepared.

Into each of eleven flasks 25·65 c.c. of this hyposulphite was measured by a pipette delivering that amount; about 200 c.c. of water was added to each. In the first flask the quantity of iodine solution requisite to produce a blue tint along with starch, at the ordinary temperature of the air (16° C) was determined; the second flask was heated to about 60° C., then allowed to cool, and finally titrated as before: almost the same amount of iodine being required, it appears that simply heating the hyposulphite solution does not appreciably alter the quantity of hyposulphite present.

The next eight flasks were heated to varying temperatures, and, while hot, a quantity of iodine solution, rather less than that required for the hyposulphite, as deduced from the first experiments, was added, care being taken to run the iodine direct into the warm liquid, and not down the sides of the flask, which might cause a loss of iodine by volatilisation; no smell of iodine was observed in any case. The addition of this iodine solution slightly cooling the liquids, their temperatures were again read off, the mean of the two temperatures being taken as the average; the warm liquids were then rapidly cooled by immersion of the flasks in cold water, and finally the slight excess of hyposulphite determined by iodine solution; the cooling was essential, since heat destroys the colour of the iodised starch.

The last flask was again titrated at the temperature of the air (16° C.) at the close of the experiments, to make sure that the hyposulphite had not altered spontaneously.

The numbers obtained were—

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Temperature of solution before addition of iodine solution	—	—	32	40	52	55	86	88	100	100	—
Do. after	—	—	28	36	44	46	65	78	83	85	—
Mean temperature	16 C.	25	30	38	48	50	75	83	91	92	16
C.c. of iodine required	39·6	39·4	39·8	40·0	40·1	40·1	40·7	40·9	41·4	41·2	39·5
Iodine required in excess of that normally requisite, viz., 39·5 c.c.	—	—	0·3	0·5	0·6	0·6	1·2	1·4	1·9	1·7	—
Do. in per cents of the normal quantity ..	—	—	0·75	1·25	1·5	1·5	3·0	3·5	4·75	4·25	—

From these numbers it is evident that the higher the temperature the larger is the quantity of iodine requisite before a blue colour with starch is developed, *i.e.*, the action of iodine on hyposulphite is slightly irregular at varying temperatures. Since the first action of iodine is to form tetrathionate (which, as is well known, is converted into sulphate by the action of chlorine), it appears probable that the conversion of tetrathionate into sulphate by iodine may account for the excess required. Probably, therefore, if the mode of experimenting were reversed (*i.e.*, hyposulphite added to warm iodine solution, the

* Read before the Newcastle-upon-Tyne Chemical Society, February 24th, 1870.

latter being always in excess till just the close of the experiment), a greater discrepancy would be manifest. It is difficult, however, to manipulate thus without loss of iodine by volatilisation; but it was found that an excess of iodine added to hyposulphite gradually diminished on standing some hours at the ordinary temperature, *i.e.*, less residual free iodine was found after standing than was present immediately after the addition to the hyposulphite.

Thus, 25·65 c.c. of a rather weaker hyposulphite solution than that previously used was pipetted off into each of ten well stoppered bottles; two were immediately titrated with the former iodine solution, the requisite amount of iodine as thus deduced was added to each of the others; to five of them a varying excess of iodine, and to the remaining three a varying excess of hyposulphite; thus, each of the eight originally contained the same amount of tetrathionate. After standing 24 hours in a cupboard (in the dark) at the ordinary temperature (10° — 20° C.), hyposulphite was added in slight excess to the five in which the iodine was originally in excess, and, finally, all were titrated with the iodine solution. The following numbers were obtained:—

	Original excess of Hyposulphite.	Original excess of Iodine.	Total Hyposulphite used.	Iodine equivalent to Hyposulphite (deduced from A. and B).	Total Iodine used.	Ratio of Iodine and Hyposulphite used.
A.* ..	—	—	25·65	—	63·3	2·467
B.* ..	—	—	25·63	—	63·35	2·470
C. ..	—	0·1	26·25	64·8	64·9	2·472
D. ..	—	0·2	26·4	65·2	65·1	2·466
E. ..	—	6·7	28·2	69·6	72·7	2·578
F. ..	—	16·7	31·85	78·6	82·0	2·574
G. ..	—	36·7	37·85	93·6	101·9	2·692
H. ..	1·5	—	27·45	67·8	67·9	2·474
I. ..	5·9	—	31·50	77·8	77·65	2·465
J. ..	9·7	—	35·25	87·05	87·2	2·474

* Titrated at once.

From these numbers it appears that in the three last experiments there was no action whatever between the tetrathionate present and the excess of hyposulphite; while in experiments E, F, and G, a considerable amount of iodine has *disappeared*, this amount increasing with the original excess of iodine, thus—

	E.	F.	G.
Excess of iodine	6·7	16·7	36·7
Iodine disappeared	3·1	3·4	8·3
Ditto., in per cents of the normal amount	4·4	4·3	8·9

Similarly, in another experiment with the above iodine solution diluted to one-third its former strength, after 24 hours—

	5 c.c.	13 c.c.
Original excess of iodine..		
Iodine corresponding to total hyposulphite used	163·1	164·4
Total iodine used	166·7	169·9
Excess of iodine	3·6	5·5
Ditto, in per cents of normal quantity	2·1	3·3

On the whole, therefore, these experiments indicate that when the temperature is not lower than 28° C., or when a mixed solution of hyposulphite and iodine still in excess is allowed to stand some time before finishing the titration, a deficiency in the amount of iodine may be expected, varying in amount with the circumstances: possibly, these facts may account for the results obtained by Messrs. Scherer and Rumpf.

The fact that sulphate is formed by the prolonged action of iodine on tetrathionate is indicated by the following experiments:—50 c.c. of the hyposulphite solution used in the past experiments were mixed with 150 of iodine (large excess); after standing 48 hours at the ordinary temperature in the dark, hyposulphite was added till all free iodine disappeared: chloride of barium gave with this liquid a dense cloud, which, after standing, was collected, and found by the blow-pipe to be really barium sulphate. 50 c.c. of the original hyposulphite with barium chloride gave not the slightest precipitate; after addition of a few drops of hydrochloric acid the solution did not become opalescent for a minute or more; and the precipitated sulphur after standing some hours was wholly volatile, showing that no sulphate whatever was present originally in the hyposulphite.

My best thanks are due to Mr. I. L. Bell, in whose laboratory the above experiments were carried out.

LABORATORY NOTES.

NEW APPARATUS FOR THE ANALYSIS OF CARBONATES.

So many forms of apparatus for the analysis of carbonates have been devised that it is just possible the one which is shown in the engraving may have been already suggested.

In Griffin's "Chemical Handicraft," sixteen kinds of apparatus for this purpose are described, but not one of them is of so simple a construction as that which I propose. Fritzsche's is almost as simple as mine, but it is not so manageable.

My apparatus is a light bottle, of the capacity of 75 centimetres. The lower part is divided into two compartments; in one of which the carbonate is placed, in the other the acid. By inclining the bottle, the acid may be allowed to flow over on the carbonate as gradually as the operator pleases. One or two chloride of calcium tubes are inserted through the cork. The cost of this bottle would be about 6d.

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Analyst to the City of Dublin, &c.

NOTICES OF BOOKS.

Reports on the Progress of Practical and Scientific Medicine in different parts of the World. (For the year beginning June 1st, 1868, and ending June 1st, 1869.) Edited by HORACE DOBELL, M.D., &c., assisted by numerous and distinguished coadjutors. London: Longmans, Green, and Co., 1870. Pp. 645.

IN the preface to this work, the editor asks his readers "to accept this first year's report as a fragmentary hostage of the next; it was only last December that I designed this work, and since that time I have had to open up correspondence with all parts of the world. The design of this work is to bring together in the English language, original and independent reports from all parts of the world, written by distinguished men resident in the countries they represent." As regards the contents of the

work it is a genuine *varietas delectat*. The book opens with a comparative table of weights, measures, &c., and also a table of comparison of the Fahrenheit with the Centigrade and Réaumur's thermometer; the arrangement is alphabetical, and therefore Africa takes precedence. Under this heading we meet with a very valuable record of meteorological observations on the West Coast of Africa, by Dr. J. A. B. Horton, arranged in the following manner:—Atmosphere; Exemption from what Diseases; Predisposed to what Diseases. America, as might be expected, is very well represented, and we learn from the work that this report is the production of a new society just set on foot at New York, for reporting the progress of medicine; and, owing to the embryonic condition of this society, it is not so complete as future reports will be. It is quite impossible to give in a few lines an adequate idea of the large amount of valuable and interesting matter contained in this volume. As an instance of the great variety of matter, we have an excellent paper on "Cider Colic," by J. Buckman; "On the Treatment of Pulmonary Consumption by Ether and Etherised Cod-liver Oil," Dr. B. W. Foster; there are also reports from several European countries, including remote Iceland; but we do not find reports from Russia, Spain, the Netherlands. From the colonies of the latter country there is a report by Dr. Wylie. Taking matters *en resumé*, we have to congratulte the editor on his first production.

CORRESPONDENCE.

SHELL SAND FROM THE ISLAND OF COLL.

To the Editor of the Chemical News.

SIR,—In the report of my short paper on "Shell Sand" in your last number, there is an error which I beg you will allow me to correct. I did not say that shell sand formed a strong mortar with lime, but that a strong lime was made from it by stacking it alternately with peat, and burning the stack; and that this lime, from the magnesia and silicic acid it contained, was in use almost equal to a cement.—I am, &c.,

EDWARD C. C. STANFORD, F.C.S.

Edinbarnet, Dumbartonshire, N.B.
February 28, 1870.

[The report was forwarded by the gentleman nominated by the Council to do so.—*Ed. C. N.*]

THE RASHNESS OF SCIENTIFIC MEN.

To the Editor of the Chemical News.

SIR,—Your well-written and excellent contemporary, the *Spectator*, said, last week, that "it seems as if no class of men drew rasher or hastier conclusions than the men of science." This was *apropos* of a recent statement as to the effect of hard and soft water upon the human constitution. Now I should very much like to know who originated this statement. Surely, if a physician, he could not have been a chemist, and, if a chemist, no physician. The *Spectator*, generally intelligent and well-informed, persists, like the *Times*, in speaking of druggists as chemists, and probably shares, too, the popular opinion that a doctor necessarily knows all about analysis and the arcana of chemical science. The investigation of the present case will, I feel confident, result in showing that the rash and hasty conclusion complained of was not drawn by a genuine man of science competent to connect a chemical fact with a physiological phenomenon. There are two many *fungoid* or pseudo-scientific men, who seize upon the results of true philosophers, and misinterpret them to the popular theme.—I am, &c.,

C.

A NEW DENTISTS' ALLOY FOR STOPPING TEETH.

To the Editor of the Chemical News.

SIR,—I have recently examined a new dental alloy which is sold for the purpose of being used as the basis of an amalgam. It occurs in the form of rather coarse filings, nearly white. Warmed in an iron spoon with a little mercury, it soon enters into intimate commixture with it. The warm amalgam, if then pressed in wash-leather in a pair of pincers, loses much mercury, and the dry amalgam thus obtained is ready for insertion into the cavity to be stopped. Its manipulation altogether much resembles that of the celebrated copper amalgam, and it seems to be quite as useful though not so hard. But it possesses this advantage over the copper amalgam (which darkens greatly) that the new amalgam retains its whiteness in the mouth. On analysis the original metal as sold gave:—

Tin	61·12 per cent
Silver	38·76 ,, ,,
Copper, &c., ...	0·12 ,, ,,
	100·00

I am, &c.,

C.

MEMORIAL OR MONUMENT?

To the Editor of the Chemical News.

SIR,—It is reported that the Faraday Memorial, for which about £1400 has been subscribed, is to take the form of a "Monument in the British Museum." I hope the report is not authentic. The project is inappropriate, useless, almost ludicrous. Faraday hated monuments, and the British Museum, which has no department of chemistry or physics, is about the last place where one would expect or wish to see a statue of our great natural philosopher. The best memorial for a great worker would be the creation of a reward or stimulus for further work. Why not found a Faraday Scolarship, or award annually a money grant and medal for a great discovery in chemistry or physics? Whatever be done should be in connection with the Royal Institution, the scene of Faraday's life and labours. The experience of the Wollaston Fund which is connected with the Geological Society, affords an excellent precedent for the present case. Our English experience in busts and statues (especially when posthumous) is not so happy as to encourage us to risk an additional failure.—I am, &c.,

A SUBSCRIBER TO A MEMORIAL, NOT A MONUMENT.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition o the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 1 1870.

This number contains the following original papers and memoirs:—

A Base Isomeric with Hydrocyanide of Ammonia (Cyanwasserstoff-Ammonia.)—H. Wichelhaus.—When orthoformic acid eth er and acetamide are heated in a sealed tube for some hours to 180°, there is formed along with alcohol a white-coloured crystalline

substance, the origin of which is explained by the following formulæ:—

$$CH(OC_2H_5)3+2C_2H_3O.NH_2=3C_2H_5O+CH\begin{cases}NH(C_2H_3O)\\N(C_2H_3O)\end{cases}$$

This substance is methenyl-diacetyl-diamine. Another product of this reaction is a substance the platinum salt of which is—

$$CN_2H_4,2HCl,PtCl_4;$$

while the base itself is CN_2H_4, termed by the author amido-methenylimide, and found to be isomeric with hydrocyanide of ammonia.

Terchloride of Iodine.—Jul. Philipp.—The terchloride of iodine does not behave with reagents as the other terchlorides do; treated with alkalies, it does not yield iodous acid (*jodige säure*), but iodic acid, while iodine is set free. This, according to the author, is due to the fact that ICl_3 is not a simple molecule, but a juxtaposition of ICl and Cl_2; and this is proved by the behaviour of the terchloride of iodine with reagents. These reactions are described at very great length, but space forbids to enter into more details.

Manufacture of Sulphuric Acid.—A. W. Hofmann.—The use of the nitric acid in the manufacture of sulphuric acid is to transfer the oxygen of the air on to the sulphurous acid; and, theoretically, therefore, a given quantity of nitric acid ought to convert an unlimited amount of sulphurous into sulphuric acid. That this is not obtained in practice can hardly be wondered at, since no manufacturing processes can be conducted absolutely without loss; but the loss of nitric acid in the manufacture of sulphuric acid, even when proper care is taken to ensure good working of the chambers, is so large that the inference is quite justifiable that there are peculiar chemical reactions at play. The study of these reactions has occupied the author, who states that, although he has not solved the problem entirely, he has obtained results worth communicating. When sulphurous acid is caused to pass into nitric acid which contains some sulphuric acid (sp. gr., 1·676 to 1·714), the nitric acid is converted into compounds which form, along with the sulphuric acid present, the so-called chamber crystals, without any perceptible formation of protoxide of nitrogen; but, when the nitric acid is impregnated with a sulphuric acid (sp. gr., 1·532), and the experiment just alluded to repeated, there is formed a considerable quantity of nitrogen, which is, of course, quite as injurious to the process as the presence and formation of protoxide of nitrogen. The explanation of this phenomenon is the insufficient strength of the sulphuric acid to form, in combination with the higher degrees of oxidation of nitrogen, the so-called chamber crystals. This having been ascertained, the author applied his knowledge of these facts in the following manner on the large scale:—The quantity of steam admitted to the first chamber (the so-called Tambour) was so regulated as to produce acid only at 60° Beaumé (sp. gr., 1·714 = 143° Twaddle), with the striking result, fully confirming the laboratory experiment, that a far smaller quantity of nitric acid was required for the same production of sulphuric acid. The author adds, that if, by accident, the strength of the acid in the aforesaid chamber should fall below the sp. gr. just alluded to, it can be easily brought up to that strength by the addition of acid of 66° Beaumé (sp. gr., 1·847) = 169 Twaddle. By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt.

Derivatives from Guanidine.—F. Tiemann.—The author describes—Naphthyldiphenyl-guanidine—

$$C_{23}H_{19}N_3=\left\{\begin{matrix}IV\\C\\C_{10}H_7\\(C_6H_5)_2\\H_2\end{matrix}\right\}N_3;$$

naphthyltolylphenyl-guanidine—

$$C_{24}H_{21}N_3=\left\{\begin{matrix}IV\\C\\C_{10}H_7\\C_7H_7\\C_6H_5\\H_2\end{matrix}\right\}N_3;$$

diacetolylendiamine—

$$C_{11}H_{14}N_2O_2=\left\{\begin{matrix}C_7H_7\\(C_2H_3O)_2\\H_2\end{matrix}\right\}N_2;$$

and treats, at great length, of the preparation and complicated reactions by which these substances are obtained.

Ethyl Combinations of Thallium.—C. Hansen.—Thallium-diethyl-chloride, $Tl(C_2H_5)_2Cl$, a solid substance, soluble in boiling water, ether, and alcohol, is affected by light similarly to chloride of silver; slowly heated to 225°, it does not melt, but is charred; rapidly exposure to heat causes its instantaneous decomposition, accompanied by explosion, yielding a mixture of ethylen, ethylic hydride, and chloride of thallium; this decomposition ensues, therefore, according to the formula $Tl(C_2H_5)_2Cl = TlCl + C_2H_4 + C_2H_6$. Sulpho-thallium-diethyl, $(Tl[C_2H_5]_2)_2SO_4$, also a solid substance, crystallising in a foliated mass, soluble in water, ether, and alcohol. Nitro-thallium-diethyl, $Tl(C_2H_5)_2NO_3$, a solid body, very readily decomposable by heat.

Silico-Proplonic Acid.—C. Friedel and A. Ladenburg.—A lengthy and exhaustive monograph.

Contribution to Explain Chemical Phenomena according to Mechanical Principles.—Dr. J. W. Gunning.

Appendix to the Researches on the Guaiacum Copper Reaction.—Ed. Schaer.—This is a supplementary part to the author's researches on this subject as detailed in the foregoing number of this periodical, but not suitable for abstraction.

Regressive Formations (Regressiv Bildungen) by Tri-Substituted Guanidines.—V. Merz and W. Weith.

Diamines Derived from α and β Dinitronaphthalines.—A. de Aguiar.—This paper, and the immediately foregoing, are too lengthy and too full of formulæ and diagrams to admit of any useful abstraction.

Researches on Xantho-Cobalt, Roseo-Cobalt, and Purpureo-Cobalt.—W. Gibbs.—The author states that, as an addition to his researches on xantho-cobalt, he has discovered the roseo- and purpureo-cobalt; the chloride of xantho-cobalt, $CO_3(NO_2)_4.Cl+4NaCl$; chloride of purpureo-cobalt, $10NH_3.CO_3.Cl_6+4NaNO_3$. The memoir is an accumulation of formulæ, some of which are so lengthy that they occupy from two to four lines in print. The paper does not state anything about the origin or preparation of the substances, named along with several others.

Lecture Experiments.—J. Schoras.—(1.) *On Some Peculiar Actions of the Sun's Rays.*—When it is desired to prove the reducing action of oxalic acid upon metallic chlorides, it is a well-known experiment to boil a solution of chloride of gold to which oxalic acid solution has been previously added. The lecturer quotes, at the same time, another instance of this kind—viz., that a solution of chloride of mercury (corrosive sublimate), when treated in the same manner, is reduced to subchloride (calomel). When, during the lecture, this experiment is made too hurriedly, for the sake of saving time, the only appearance seen is the feeble turbidity produced by the separation of a mere cloud of calomel; and, even if the boiling is continued for some time, it is readily seen that this reaction is not quite complete. When, however, a solution of perchloride of mercury is, after the addition of oxalic acid, exposed to the action of direct sunlight, the copious precipitation of calomel ensues, after a few minutes' exposure, in the shape of brilliant mother-of-pearl-like scales, which, illuminated by the direct sunlight they are formed by, give rise to a beautiful phenomenon. If this sediment is collected, and dried at 110°, it will be found, on analysis, to contain 15·2 per cent of chlorine, thus proving it to be calomel. This experiment, and the undermentioned, can, however, only be tried in our latitude when the sun is at its zenith, in July. When a solution of Berlin blue in oxalic acid is exposed to the direct rays of the sun, a sudden precipitation of Berlin blue ensues, and, instead of a deep-coloured, almost non-transparent fluid, a perfectly clear colourless liquid is exhibited. It is a well-known fact that solutions of the per-salts of iron and uranium, to which oxalic acid is added, are, on being exposed to direct sunlight, converted to solutions of the protoxides of the metals, while carbonic acid is given off. The perchlorides answer best for experiments; a solution of perchloride of iron, to which tartaric acid has been added, is acted upon in a manner which is not quite explained. Such a solution is used in photography, in the so-called carbon process. A collodion plate, impregnated with the iron solution referred to, and dried in the dark, obtains, on exposure to light, the property of retaining, energetically, at the portions affected by the light, finely-divided substances—as, for instance, powdered black-lead, English red, finely-divided metals, and metallic oxides. The quantity of the powders thus adhering depends upon the greater or lesser intensity of the light which has fallen on it; and it is this condition which defines the various depths of hues and shades, and renders the stereometrical representation of the object possible. Photographers say that the action of the light has rendered the salt hygroscopic, and that this property causes the adhesion of the pulverulent substances. Whatever the action may be, the author states that a reduction process is in play. A solution of chloride of iron, to which tartaric acid had been previously added, and the colour of which was deep yellow, became, when exposed to direct sunlight, quite colourless; an evident proof that reduction had taken place. When a solution of peroxide of iron in tartaric acid is exposed to direct sunlight, a copious sediment of a crystalline yellowish green-coloured substance is thrown down. Since reduction takes place here on the one hand, oxidation must take place, of necessity, on the other; but it is not accompanied by any evolution of gas. The author reserves further study and experiments on this subject, which, as he very properly observes, may throw light upon many processes going on in animal and vegetable life. (2.) *Peculiar Phenomena of Colouration Exhibited by Some of the Platino-Cyanides.*—Gmelin was the first discoverer of potassium platino-cyanide; MM. Quadrat and Schafarik obtained similar compounds afterwards. We owe to Dr. Martius a valuable and exhaustive work on these substances and their composition. It is well-known that many of these salts are remarkable for a strong di- and tri-chroism; and this induced the author of this paper, while preparing a series of these salts, to make some very curious observations thereon, which are described as follows:—The calcium and magnesium salt of this series lose their water of crystallisation completely at a comparatively low temperature, and take it up again on cooling with great ease and rapidity. The anhydrous salts are white—the hydrated are coloured; therefore, paper and other suitable materials impregnated with solutions of these salts, become coloured. But a slight elevation of temperature is sufficient to decolourise them; and, on cooling, the colour reappears, in consequence of the more or less ease and rapidity wherewith the water of crystallisation is taken up. A slip of paper impregnated with a solution of magnesium platino-cyanide, exhibits, after drying, a beautifully bright red colour. A slight elevation of temperature is sufficient to render the salt anhydrous, and to temporarily destroy the colour entirely, which, however, reappears on cooling; while the re-taking up of the water may be aided by breathing over the paper. A slip of paper impregnated with a solution of calcium platino-cyanide exhibits, after drying, a bright canary-yellow colour; on being warmed, dehydration of the salt takes place, and, consequently, its complete decolouration; removal from the source of heat, accompanied by gentle breathing over the paper, is sufficient to restore the colour. When these experiments are made at night-time, magnesium light should be employed to render

the true colours (especially the yellow) properly visible. The barium salt is also yellow-coloured, but is not so sensitive for the purpose as the calcium salt. When a mixture of the solution of the barium salt along with the potassium salt of this series is taken for the purpose of impregnating paper, that material exhibits, after drying, an unsightly yellow colour, which has the property of changing, by gently heating, from yellow to orange and red; and if the heat be increased, the original colour returns. While cooling, the piece of paper impregnated with the salt exhibits the phenomenon of passing through the same series of shades of different colours already alluded to—viz., yellow, orange, red, and again whitish yellow, the original colour. The lithium platino-cyanide is deliquescent, and hence unsuited for any experiments of a similar nature; the ammonium salt exhibits, while being evaporated to dryness on a porcelain basin, most curious brown-red colourations. The author suggests that if, while experimenting with these impregnated slips of paper in a lecture-room, any of them become ignited and burn to ash, this should be taken upon the feather of a quill, and immediately removed to a jar containing a mixture of oxygen and hydrogen (in the proportions to form water), and thus show the action of the spongy platinum left in the ash. The slips of paper impregnated with the calcium salt may, after having been previously decoloured by the application of heat, be very suitably applied for the detection of the least trace of moisture, since that has the effect of at once restoring the yellow colour. The author particularly points out that, since all the salts here spoken of are most violent poisons, they should not be used, or experimented with, but by parties who can be trusted with such matters; fortunately, also, the preparation is an expensive operation, as well as one requiring great skill and more knowledge than is common with those who usually undertake the preparation of chemical substances for sale as amusing toys.

Bulletin de la Société Chimique de Paris, January, 1870.

From the *procès verbaux* of the meetings of the Society, we learn that M. J. Gautier gave a brief communication on the following questions:—Is the temperature at which two gases combine invariable? What influence is exerted by the products of their mutual reaction? What influence is exerted by any impurities purposely added? The author states that he is engaged in researches to answer these questions, and gave the following account of the results hitherto obtained:—A mixture of 2 volumes of hydrogen and 1 of oxygen having been made, this was exposed to incipient red heat, when it was found that union of the two gases takes place without being attended by any explosion. When heated by means of a Bunsen gas burner, union takes place instantaneously; and at an intermediate temperature between the first and last-named, union takes place rapidly, but without any explosion. Oxide of carbon unites with oxygen below red heat visible by daylight; chlorine and hydrogen, placed in absolutely opaque and sealed tubes, begin to form chlorhydric acid at 190°, and at 200° the combination becomes rapid. M. J. Friedel communicates that he has obtained oxide of amyl by heating, to 200°, amylic alcohol with one-tenth of its weight of iodide of amyl. The products of the reaction are—Water, amylen, amylic alcohol (mixed with some iodide of amyl and oxide of amyl; the latter in quantity of about one-third of the alcohol employed. Dr. Prinvault states that, when he made bromine act upon protochloride of phosphorus, a brownish coloured oil was obtained, boiling at 75°; this liquid was found to consist of a fluid, $PBr_5+3ClBr$, and a solid substance deposited on cooling in prismatic crystals, $PBr_5+2ClBr$. When protochloride of phosphorus is made to act on bromine, a solid substance, fusing at 45°, and crystallising in oblique prisms, is obtained; formula, PCl_3Br_4. Heat decomposes these, yielding the protochloride and PCl_3Br_8.

The following papers and memoirs were read or deposited:—

Relation Existing between the Variation of the Crystalline Shape of Alum and the Menstruum it is Crystallised from.—E. Janettaz.—After referring to the labours of MM. Weber and Bendaut Lévy on this subject, the author describes a series of experiments made with the view of eliciting answers to the following questions:—Does the menstruum affect the composition of the crystals of alum? Are the isomorphous alums influenced in the same way by identical conditions? Is the action of acids isomorphous with hydrochloric acid the same? Supposing an alum to have been modified by hydrochloric acid, to be next dissolved by water, does the hemiedric condition remain? Is the complex form exhibited by these substances the result of all the bodies simultaneously in solution with them? Is any free acid required for the purpose of imparting to these substances a peculiar crystalline form? The lengthy memoir is rather a crystallographical essay.

Researches on the Action of Oxychloride of Carbon upon the Carbides of Hydrogen.—Dr. Berthelot.—In the introduction to this memoir, the author says that, while experimenting with oxychloride of carbon, he found, to his surprise, that this gas does not possess the chemical activity commonly attributed to it of late. This discovery induced him to repeat Harnitzky's experiments on the synthesis of organic acids, by causing the oxychloride of carbon to react upon carbides of hydrogen. The author states that, notwithstanding every exertion made by him, he did not succeed in obtaining any of these substances; and relates, at great length, what reactions, if any at all did take place, between the oxychloride and marsh-gas; acetylen and benzol; oxychloride, with excess of chlorine; nascent oxychloride and an impure oxychloride; and the same hydrocarbides.

History of Oxychloride of Carbon.—Dr. Berthelot.—The most salient part of this paper is that, when oxychloride of potassa is placed in contact with slightly-damped bicarbonate of potassa, the volume of the gas increases three-fold, and is still completely absorbed by caustic potassa—

$$C_2O_2Cl_2+2(C_2O_4.KO.HO)=3C_2O_4+2KCl+H_2O_2.$$

Analyses of Mixtures of Gases Containing Oxychloride of Carbon.—Dr. Berthelot.—Suppose a gas mixture to contain chlorine, oxychloride of carbon, oxide of carbon, oxygen, and nitrogen. Shake the mixture first with some mercury, to remove the chlorine; caustic potassa solution removes oxychloride; pyrogallate of potassa removes oxygen; protochloride of copper removes oxide of carbon. Let the mixture contain—Oxychloride of carbon, hydrochloric acid, carbonic acid, oxide of carbon or carburetted hydrogens, oxygen, and nitrogen. Mercury is applied for the removal of chlorine. One single drop of water dissolves and takes the hydrochloric acid, without affecting either the oxychloride or carbonic acid; one single drop of absolute alcohol first dissolves the oxychloride, converting it into an ether which, along with any vapour of alcohol, is removed by a drop of concentrated sulphuric acid. The residue is treated by a single drop of a concentrated solution of caustic potassa, which takes up carbonic acid; the oxygen is removed by pyrogallate of potassa, the hydrocarbides by bromine, and the oxide of carbon by protochloride of copper.

On Chloride of Acetylen, and on the Synthesis of Julin's Chloride.—Drs. Berthelot and Jungfleisch.

Action of Hydrate of Potassa upon the Sulphuric Acid Derivatives of Hydrocarbons.—Dr. Berthelot.

Synthesis of Acetic Acid from Acetylen.—Dr. Berthelot.—These three papers have appeared in a condensed state in the *Comptes Rendus*, and were noticed by us.

Products of the Condensation of Valeric Aldehyde.—J. Riban.—The author states that his chief object is to say that, while M. Borodine has preceded him in the publishing of results obtained on this subject (see CHEMICAL NEWS, vol. xx., p. 286, quoted by J. Riban), he reserves to himself the right of giving his experiments, as made at a date anterior to M. Borodine's, whose researches he confirms as correct.

Salicilonitrile.—E. Grimaux.—A continuation of a former paper.

On Phenate of Isopropyl and some Bromated Derivatives.—R. D. Silva.—Phenate of isopropyl, $C_6H_5(CH_3-CH-CH_3)O$, is a colourless, somewhat viscous liquid, smelling like essence of geranium; boils at 176°; sp. gr. at 0°, 0·958; refraction index, 1·5124; vapour density, 4·73. Monobromated isopropyl, $C_6H_4Br(CH_3-CH-CH_3)O$, a colourless, rather viscous liquid, insoluble in water, soluble in alcohol and ether, and boiling at 236°; sp. gr. at 0°, 1·981. Perbromated phenate of isopropyl, a solid substance fusing at 95°.

Bromotoluen and Paratoluidine,—O. Wallach.—The main object of this paper is a rectification of errors committed, according to to the authors, at least, by M. Rosensteihl, who stated that the author had mistaken a mixture of pseudo-toluidine and toluidine for a bromotoluen.

Letter from M. Kraut to the Editor of the "Bulletin," Requesting Correction of some Abstracts from M. Kraut's Paper on Salicylic Compounds.—A brief notice, the greater portion of which is occupied with formulæ—*e.g.*, trisalicylosalicylic acid—

$$H.O.C_6H_4.CO.OC_6H_4CO.O.C_6H_4CO.O.C_6H_4.CO.O.H.$$

Annales du Genie Civil, January, 1870.

This periodical rarely contains original papers on chemistry and allied sciences; but this number contains a paper on—

Soap and Soap Making.—L. Droux.—Divided into several sections. Introduction; from what time, or period, does the making of soap date? soap was known to the ancients; soap making at Marseilles in the 17th century; artificially-made soda, vegetable oils, and oleic acid; distribution of the soap-works over Europe; soft soap unknown and never used in southern countries; legislative enactments, as regards soap and the fiscal duties thereon; statistical review of the importance of the soap manufacture in France, the United Kingdom, and other European countries. This is simply the skeleton of the contents of this, in many respects, very important paper. Soap, the author proves, was known to the ancients at a very remote period, but its manufacture was not generally well understood. It appears we are in Europe indebted to the Saracens for the re-discovery of the manufacture of soap, as much as for the discovery of the manufacture of paper, sugar refining, and other industrial arts.

Zeitschrift für Chemie von Beilstein, No. 3, 1870.

This number contains the following original papers:—

Formation of Ozone During Active Combustion.—O. Loew.—After referring to the well-known instances of the formation of ozone during slow combustion and oxidation, the author gives the opinion that every act of oxidation, whether slow or more rapid, is accompanied by the formation of ozone just previous to the combination between the substance to be oxidised and the oxygen converted into a state of great activity taking place. The following experiment is described to prove this dictum:—A current of air is blown through a rather wide glass tube towards the flame of a Bunsen gas burner; and opposite the end of the tube, which is directed towards the flame, a suitably-sized beaker-glass is held; and after a few seconds, the blowing is discontinued, and the beaker-glass simultaneously covered with a glass plate. When the air contained in the beaker-glass is tested, it will be found to emit the peculiar odour of ozone, to blue

guaiacum paper, and to separate iodine from iodide of potassium. The formation of ozone is greatest when the current of air is so strong as nearly to cause the extinguishing of the flame. The experiment succeeds with every other kind of flame, provided care be taken so to regulate the current of air as to exclude the presence of intermediate products of combustion, as, for instance, vapours of partly-consumed alcohol, if a spirit-flame be used. The author draws from his researches the following conclusions:—(1) Oxygen is first converted into ozone in every case where active combustion takes place. (2) Far more ozone is formed than is required for the keeping up of the process of complete combustion and oxidation of the oxidisable material. This surplus of ozone is, in all ordinary cases of combustion, destroyed, partly by the high temperature, and partly by the rush of cold air, and draught thereby caused, attending the combustion.

Dissociation of Fluid Sulphuric Acid, and on a General Method of Estimation of the Degree of Dissociation of a Fluid Compound.—L. Pfaundler.—The author first briefly refers to W. Dittmar's paper on this subject, and next gives a lengthy tabulated form, exhibiting the results of his researches on the dissociation of sulphuric acid, finishing his paper with a number of algebraical formulæ suitable for the calculation of the degree of dissociation of any fluid compound.

Regressive Formations (Regressiv Bildungen) of the Tri-Substituted Guanidines.—V. Merz and W. Weith.—It is rather to be regretted that the authors of this paper have not commenced it by giving a concise explanation of what they understand by regressive formations, which is not at all clear from the contents. Sulpho-carbanilide is decomposed (so the paper begins), by the action of heat, into triphenyl-guanidine, sulphide of carbon, and sulphuretted hydrogen. From the further contents and description of experiments, it would appear that, by regressive formation, is meant a regeneration of a substance—say, sulpho-carbanilide—while being heated, so that, instead of its entire decomposition as final result, there is found a large quantity (the authors mention even 90 per cent) of the substance unacted upon by heat. The chief illustration given of what is understood by the regressive (better, perhaps, in English, regenerative) process is rendered by the following formulæ, referring to the two reactions by which sulpho-carbanilide can be obtained from triphenyl-guanidine; the formulæ hold good, also, regressively:—

$$N\langle^{C_6H_5}_{H} \qquad N\langle^{C_6H_5}_{H}$$
$$| \qquad\qquad |$$
$$C=NC_6H_5+CS_2 = C=S + C\langle^{S}_{NC_6H_5}$$
$$| \qquad\qquad |$$
$$N\langle^{H}_{C_6H_5} \qquad N\langle^{H}_{C_6H_5}$$

$$N\langle^{C_6H_5}_{H} \qquad N\langle^{C_6H_5}_{H}$$
$$| \qquad\qquad |$$
$$C=NC_6H_5+H_2S = C=S + C_6H_5.NH_2$$
$$| \qquad\qquad |$$
$$N\langle^{H}_{C_6H_5} \qquad N\langle^{H}_{C_6H_5}$$

Note on Oxalate of Silver.—F. A. Mühlhäuser.—The author says, Drs. Thudichum and Wanklyn stated some time ago, in contradiction to Gmelin, that oxalate of silver is an anhydrous salt; but, however correct the statement of the gentlemen just named may be, it is no novelty at all, having been long since mentioned in the *Annalen der Chemie* (101, 177). The author adds—It would have been of far more value to science if the parties had communicated their mode and means of correctly analysing a salt which is very readily decomposed with explosion.

Products of Condensation from Oenanthol.—Hugo Schiff.—About twenty-one years ago, says the author, Dr. Williamson found that a solution of oenanthol in 4 volumes of alcohol, saturated with HCl, yielded, on addition of water, oenanthic ether. The author contradicts this, stating at the same time that Dr. Williamson's oenanthol has been, in all probability, largely contaminated with oenanthic acid, since pure oenanthol, previously saturated with HCl and dissolved in alcohol, separates into two layers, distinctly exhibiting a different specific gravity. The chief product of this reaction is septen-oxyethyl-chloride—

$$C_7H_{14}\begin{cases}O.C_2H_5\\Cl\end{cases}$$

a substance insoluble in water, soluble in alcohol and ether, and becoming gradually decomposed, even by the addition of warm water. This substance is dissociated by distillation, yielding hydrochloric acid, ethylen, chloride of ethyl, steam, a mixture of hydrocarbons, and a couple of oxygenated compounds. The following products of fractional distillation were obtained from the residue of the first distillation, carried on to 320°:—Oenanthylen, C_7H_{14}, boiling-point, 90—100°; a fluid boiling between 245° and 260°, $C_{14}H_{26}$; boiling between 320° and 330°, $C_{14}H_{28}$; residue left at 350°, $C_{14}H_{12}$. The remainder of this paper is devoted to a lengthy discussion, accompanied by a large number of formulæ, to explain how the different substances and products of the complex reactions are derived from the original material applied for the preparations.

Sulpho-Fumaric Acid.—B. Credner.—Sulpho-fumaric acid, $COOH.CH_2.CHSO_3OH.COOH$.—The preparation and purification of this substance are described at length; the process is complicated and tedious. The pure material is a syrup-like, very sour fluid, which, by being kept over sulphuric acid, yields traces of crystalline appearance; the acid and its salts, a number of which are described, are isomeric, but not identical with sulpho-succinic acid. Sulpho-fumarate of potassa, $C_4H_2K_2SO_7+H_2O$, is a crystalline mass which effloresces on exposure to air. Neutral sulpho-fumarate of lead—

$$C_4H_2Pb_2O_7S + 2H_2O,$$

is a salt readily soluble in water, in aqueous solution of acetate of lead, and in free acids, and obtained by double decomposition of a potassa salt of the acid in question, can never be obtained quite free from potassa. The basic lead-salt of this acid, $C_4H_2Pb_2O_7S+Pb_2O$, is a crystalline compound, rather insoluble in most menstrua.

Behaviour of Salicylic Aldehyde when it is Heated with Primary Monamides.—B. Credner.—This paper treats of the action of acetamide upon salicylic acid at an elevated temperature, resulting in the formation of a substance soluble in alcohol, yielding, on elementary organic analysis, in 100 parts:—C, 57·82, 58·56, 64·35; H, 5·80, 6·18, 5·55,; N, 8·01, 7·81. After purification with alcohol, the figures obtained were—C, 65·33, 68·48, 66·29, 63·27; H, 5·81, 6·40, 5·73, 5·69; N, 8·11, 7·35. When salicylic aldehyde was heated with benzamide, a similar substance was obtained.

NOTES AND QUERIES.

Estimating the Amount of Lamp-Black in Graphite.—Will any of your readers kindly inform me, if there is any accurate method by which the amount of lamp-black may be estimated in samples of graphite adulterated with it.—J. REDDROP.

Coprolite and Bone in Mixed Superphosphates.—Can anyone give me a process to quantitatively determine the relative amounts of coprolite and bone in a mixed superphosphate?—W. M. B.

Money-Values of Substances Found in Artificial Manures.—I have occasional applications made to me to add to my certificates of analysis of manurial substances the "value at prices fixed by chemists." I have not done so, for the twofold reason that (1) I do not consider it within the province of the analyst, and (2) that I do not know what the prices are. Can anyone, therefore, kindly inform me if this custom obtains amongst respectable analysts? and, if so, what are the various money-values of the substances found in the artificial manures now in use?—W. M. B.

MEETINGS FOR THE WEEK.

MONDAY, March 7th.—Royal Institution, 2. General Monthly Meeting.
——— Medical, 8.
——— London Institution, 4.
TUESDAY, 8th.—Royal Institution, 3. Dr. Masters, on "Plant Life."
——— Institution of Civil Engineers, 8.
——— Photographic, 8.
——— Ethnological, 8.
WEDNESDAY, 9th.—Society of Arts, 8.
——— Geological, 8.
——— Microscopical, 8
THURSDAY, 10th.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."
——— London Institution, 7.30.
——— Royal, 8.
——— Zoological, 8.30.
——— Royal Society Club, 6.
FRIDAY, 11th.—Royal Institution, 8. Prof. Westmacott, "On Art."
——— Astronomical, 8.
——— Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

*** Vol. XX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxi. commenced on January 7th, and will be complete in twenty-six numbers.

R. Noel Hartley.—Your paper, "Concerning Atom-Fixing and Atom-Displacing Powers," will appear in our next.

T. Y.—Consult the Index; you will find communications on the subjects you name.

C. D. H.—H. Baillière, of 219, Regent Street, or any foreign bookseller.

Capt. W. A. Ross, R.A.—In our issue of December 3rd, 1869, we expressed our regret at not having space for your articles. The great demand on our space obliges us to omit articles which appear to be of but little interest to our readers.

A. Freire-Marreco.—When the papers are of great length we should prefer a condensed report, but when important we will always endeavour to insert them unabridged.

BOOKS RECEIVED.

On the Absorptive Power of Soil, by Robert Warington, F.C.S. Reprinted from "Practice with Science," vol. ii., 1869.
The Food Journal for March.
The Sugar-Cane for March.
On the Influence of Mental Activity on the Excretion of Phosphoric Acid by the Kidneys, by Luther Hodges Wood, Ph.B., M.D.

THE CHEMICAL NEWS.

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CONCERNING

ATOM-FIXING AND ATOM-DISPLACING POWERS.

By WALTER NOEL HARTLEY, F.C.S.

Part I.

In Hofmann's "Modern Chemistry" occur these words: "The atomic relations which we call quantivalence imply not only atom-fixing, but atom-displacing power; so that, in learning how many standard units of quantivalence any given elementary atom may attract and retain within a compound molecule, we learn, also, how many it can remove therefrom." According to notions now received, and facts recorded, this, with a certain class of compounds, would appear not to be the case. In Hofmann's work, nitrogen and its congeners are treated as merely trivalent; but they are now well-known to have pentad functions.

Many compounds have been obtained by Griess,* in which N substitutes H_3, for instance—

$C_6H_2(NO_2)_2N_2O$,	Azopicramic acid.
$C_{12}H_{11}N_3$,	Azodianiline.
$C_{12}H_8N_4$,	Diazodianiline.

I can find, however, no instance of its displacing five standard atoms; on the other hand, in ammonium-chloride it fixes five. Here, then, is an example, showing that atom-fixing is not identical with atom-displacing power. Again, P, which is trivalent to H, is both a triad and a pentad to Cl—*e.g.*, $PCl_3.PCl_5$. From consideration of these and similar facts, I believe that, in certain elements, the full atom-fixing or displacing power is not exercised, but is partially suppressed or lies latent. For instance, Strecker obtained azobenzoic acid, in which N displaces only one atom of hydrogen, $C_{14}H_{10}N_2O_4$; by treating this with ferrous hydrate, the N takes up H; by boiling with hydrochloric acid, one other atom, H; and subsequently it fixes HCl, thus:—

$C_{14}H_{10}N_2O_4$.	$C_{14}H_{12}N_2O_4$.	$C_7H_7NO_2$.	$C_7H_7NO_2-HCl$.
Azobenzoic acid.	Hydrazobenzoic acid.	Amidobenzoic acid.	Amidobenzoic hydrochloride.

In the first instance, four atom-fixing powers lie latent, and they are gradually revealed until a saturated compound results.

Elements of the nitrogen class† have a much greater power of fixing three atoms than five, their most stable compounds being triadic; in fact, these compounds act as bivalent radicles, and fix two other atoms, thus:—

$$NH_3HCl, \quad PCl_3.Cl_2, \quad SbCl_3.Cl_2,$$

just as certain oxygen compounds do—*e.g.*,

$$NO''Cl_2, \quad PO''Cl_3.$$

This is an instance of what is invariably the case—viz., that the saturating power, or quantivalence, of a compound radicle is dependent on the quantivalence of the elements entering into its composition. Seeing that, in Griess's compounds, N displaces three, instead of five atoms, and, on the other hand, in NH_4HCl it fixes five, we may infer that the two weaker atom-fixing powers are incapable of displacing atoms, although they have the power of fixing them on to a molecule. The amides bear this out:

* *Ann. Chem. und Pharm.*, vol. cxiii., p. 201.
† Odling, in Watts's "Dictionary."

NH_2 can fix three atoms; it displaces only one, however, and then fixes other two, thus—

$C_7H_5(H_2N)O_2$.	$C_7H_5(H_2N)O_2.HCl$.
Amidobenzoic acid.	Amidobenzoic hydrochloride.
$C_3H_5(H_2N)O_2$.	$C_3H_5(H_2N)O_2.HIC$.
Alanine.	Alanine hydrochloride.

Amidogen never displaces three atoms of hydrogen from a compound, because atom-fixing is not identical with atom-displacing power.

The compound HCN has the H combined with the C. Nitrogen being a pentad, the carbon is insufficient to saturate it; we have, therefore, two free atom-fixing powers of the nitrogen in this body. Naquet mentions this in his "Cours de Chimie." The cyanides then have the following constitution:—

$$\text{Cyanides,} \quad C^{IV}\begin{Bmatrix} N^{V} \\ M \end{Bmatrix}$$

$$\text{Isocyanides,} \quad N^{V}\begin{Bmatrix} C^{IV} \\ M \end{Bmatrix}$$

M = a metallic body.

Cyanogen is, then, a trivalent radicle; the crystalline compounds of Gauthier and Gal, of prussic acid with the haloid acids, abolish the need of any further proof of this.

$$HCN.HCl, \ HCN.HBr, \ HCN.HI, \text{ or } C^{IV}\begin{Bmatrix} N^{V} \\ H \end{Bmatrix}.HCl.$$

Hydrocyanic acid is a tertiary monamine, in which the radicle CH''' replaces three hydrogen atoms—

$$CH''' \}N.HCl.$$

The double cyanides of silver and potassium, also chlorocyanide of silver and potassium, may be thus represented:—

$$\begin{matrix} CN—Ag \\ \| \\ K—CN \end{matrix} \quad \text{or} \quad CN'''\begin{Bmatrix} Ag \\ K \\ Cl \end{Bmatrix}$$

A trivalent radicle, when doubled to form one molecule, may become either tetrad or dyad; when trebled, either monad, triad, or pentad, in its functions, according to its inner constitution, thus:—

$$2(X''') = (\text{molecule})^{\text{IV or II.}}$$

$$3(X''') = (\text{molecule})^{\text{I, III, or V.}}$$

From this it is easy to see how the immense variety of complicated cyanides arise; to take the mercury compounds first, we have—

$(Hg''Cy_2)''.KBr.$	$C_2H_5Cy.CyCl.$
$(Hg''Cy_2)''.NaBr.$	$C_2H_5Cy.CO''Cl_2.$
$(Hg''Cy_2)''.NH_4Cl.$	
$(Hg''Cy_2)''.KCl.$	
$(Hg''Cy_2)''.NaCl.$	
$(Hg''Cy_2)''.KI.$	
$(Hg''Cy_2)''.Ag.NO_3.$	

Of all unstable substances, cyanide of ammonium is most strangely so; it gives off ammonia and hydrocyanic acid at ordinary temperatures, and simultaneously. The reason of this is apparent when we consider that the weaker atom-fixing powers of the nitrogen in the ammonium are united to the weaker ones of the same element in the hydrocyanic acid, thus:—

$$\left.\begin{matrix} H \\ H \\ H \end{matrix}\right\} N^{V}.NCH, \quad \text{or} \quad \begin{matrix} N^{V} \equiv C^{II}H \\ \| \\ H_3 \equiv N \end{matrix}$$

Amidogen, H_2N, is an analogue of cyanogen—that is to say, it replaces an atom of hydrogen or chlorine in various compounds.

It is evident that it resembles it closely, in being trivalent as well as univalent, in the same manner as cyanogen, by virtue of the two weaker atom-fixing powers of its nitrogen. The ammonium haloid salts resemble the compounds of Gauthler and Gal, thus:—

$$(Cy'''\overline{H}.)''HCl.$$
$$(Am'''H)''.HCl.$$

It is only necessary to recall the fact that amidogen displaces H from a molecule, and then fixes HCl in order to prove its trivalency.

Chlorine and its congeners form an exceedingly well-defined group of radicles; any compound into which one of these enters is sure to have its analogue, in which the others take part. In addition, however, to the halogens, the mono-metallic bodies come under the same quantivalential class; they form analogous compounds, have the same atomic heat,* and the same capability of displacing each other.

These elements, resembling each other to such an extent in their general powers of forming and entering into compounds, are—

H.	Tl.
K.	Au.
Na.	F. (?)
Ag.	Cl.
Cæ. (?)	Br.
R. (?)	I.

Of this list, thallium and gold are always admitted to be triads; iodine was shown by Schutzenberger† to be a triad; and Wanklyn has shown the possibility of sodium possessing triad functions. The compounds relating to this question are the following:—

$$\underbrace{I\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix}}_{\text{Iodine trichloride.}} \qquad \underbrace{I\begin{Bmatrix}C_2H_2\\C_2H_2\\C_2H_2\end{Bmatrix}\begin{Bmatrix}HO_2\\HO_2\\HO_2\end{Bmatrix}}_{\text{Iodotriacetic acid.}} \qquad \underbrace{Na\begin{Bmatrix}C_2H_3O\\C_2H_3O\\C_2H_3O\end{Bmatrix}}_{\text{Sodium triacetyl.}}$$

$$\text{Thallic chloride, } Tl\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix}$$

$$\text{Gold chloride, } Au\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix}$$

Of the above twelve elements, three are comparatively little known—Cæ, R, and F; of the remaining nine, four are shown to be triads, but their monad characters are the much more marked, just as in the nitrogen group. The trivalent are more predominant than the pentad functions; the reason of this I consider to be the same in each case; two of the atom-fixing powers in each class of radicles are weaker than the others. As nitrogen and its congeners have a greater power of combining with three than five atoms, so these elements have a greater power of combining with one than three. It is not at all satisfactory, when contemplating such compounds as sodium-triacetyl, iodo-triacetic acid, and iodic chloride, to be unable to account for these under the orthodox views; it rids us of the difficulty; but it is still less satisfactory to ignore their existence altogether.

A monad atom can form only one combination with any other monad; this is represented by XA; it is a union of atom with atom. It is impossible for this combination to unite with anything else, both elements being saturated.

Let us consider now what combinations of iodine—for instance, with univalent radicles, and apparently saturated compounds, exist.

(*a*)	(*b*)	(*c*)	(*d*)
$KI.TlI_3$	$N\begin{Bmatrix}(CH_3)_4\\I_3\end{Bmatrix}$	$N\begin{Bmatrix}(CH_3)_4\\I\end{Bmatrix}$	$N\begin{Bmatrix}(CH_3)_4\\I_{10}\end{Bmatrix}$

How is it possible to account for these?

Recognise I as trivalent, and the problem is without difficulty.

$$2 \text{ atoms } I = (I_2)^{\text{II or IV}}$$
$$3 \text{ atoms } I = (I_3)^{\text{I, III, or V}}$$

In (*a*), the iodine of the potassium unites with that of the thallium, and together they form a di or tetra molecule, to saturate K and Tl. With (*b*) and (*c*), the molecules* (I_3''') and (I_5''') are both univalent, and therefore fill up the unsaturated combinations—

$$N\{(CH_3)_4.$$

The substance (*d*) is more unstable than the others, which is natural from its being, perhaps, an unsaturated molecule—

$$N\begin{Bmatrix}(CH_3)_4\\I_{10}\end{Bmatrix}$$

It is possible, however, it results from such a combination as this—

$$N\begin{Bmatrix}(CH_3)_4 & (CH_3)_4\\(I_{20})''\end{Bmatrix}N$$

In either case, it does not affect the question. As for chlorine, if purely univalent in its functions, what is to become of the following bodies?

$$\underbrace{N\begin{Bmatrix}(CH_3)_4\\ICl_2\end{Bmatrix} \quad N\begin{Bmatrix}(CH_3)_4\\ICl_3\end{Bmatrix} \quad N\begin{Bmatrix}(CH_3)_4\\ICl_4\end{Bmatrix}}_{\text{Chloriodides.}} \text{ (Weltzien).}$$

It is evident their constitution is similar to that of the iodides. A few instances of double chlorides will further strengthen the evidence of triad character, *e.g.*—

$$KCl + HgCl = KHg.(Cl_2''')''$$
$$KCl + ICl_3 = K.(ICl_4)'$$
$$NaCl + PtCl_2 = NaPt''.(Cl_3)'''$$
$$NH_4Cl + AgCl = (NH_4)Ag.(Cl_2)''$$

Bromine is no exception; but fluorine I am inclined to believe to be a dyad, as suggested by Mr. Gore.†

If H and Cl be monad elements, in combination they will completely saturate each other, how comes it, then, that a completely saturated compound should unite with H_3N, a ready-formed molecule? These weaker atom-fixing powers of the nitrogen must have the power of splitting up the HCl, in order, first, to fix the atom H, and then the Cl to it; again, at a temperature of 300° C., or thereabouts, ammonium-chloride parts with HCl, again unchanged.

Now, if the constitution of sal ammoniac be—

$$N\begin{Bmatrix}H\\H\\H\\H\\Cl\end{Bmatrix}$$

It is only reasonable to expect that heat would drive off, first, either the chlorine or the hydrogen, in which case Pebal, in his experiments proving dissociation, would have found free chlorine: but no; we find the H and Cl coming off in combination. Consider chlorine from the new point of view, and chloride of ammonium like the cyanide, and then how plain is everything—$(NH_3)''.(HCl)''$. NH_3 and HCl are both divalent molecules: they combine and separate without disturbance. The following are parallel cases:—

$$N^{v}\begin{Bmatrix}H\\H\\H\end{Bmatrix} = NCH \qquad P^{v}\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix} = Cl_2 \qquad N^{v}\begin{Bmatrix}H\\H\\H\end{Bmatrix} = HCl$$

$$\ddagger P^{v}\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix} = (MeCy) \qquad P^{v}\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix} = (C_3H_7Cy) \qquad P\begin{Bmatrix}Cl\\Cl\\Cl\end{Bmatrix} = C_6H_5Cy$$

* Canizzaro.
† Wurtz ("Philosophie Chimique").

* The word molecule I use to signify a group of atoms merely.
† *Proceedings of the Royal Society*, 1869.
‡ Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 272).

We have no such easy separation of ammonia from its combinations with oxyacids; from phosphoric acid, a red heat is necessary to remove it; the nitrate decomposes in nitrous oxide and water, &c. On the other hand, another halogen salt, the iodide, decomposes at ordinary temperatures. A further illustration of the same decomposition, giving rise to an anomalous vapour density, is furnished by the bromhydride of amylene, $(C_{10}H_{10})''.HBr$."

As further evidence that various chlorides are not saturated compounds, and thus resemble hydrochloric acid, although the metallic or other radicles are combined with chlorine to their greatest extent, I will quote a few examples of nitriles united with chlorides:—

$Ti\,Cl_4.HCN$.*	$Ti\,Cl_4.MeCy$.‡	$Ti\,Cl_4.EtCy$.
$Sn\,Cl_4.2HCN$.†	$Sn\,Cl_4.MeCy$.	$Sn\,Cl_4.EtCy$.
$Sb\,Cl_5.3HCN$.†	$Sb\,Cl_5.MeCy$.	$Sb\,Cl_5.EtCy$.
$Fe_2Cl_3.2HCN$.†	$Fe_2Cl_3.MeCy$.	$Fe_2Cl_3.EtCy$.
	&c., &c.	&c., &c.

$Sb\,Cl_5.CyCl$.†
$Bo\,Cl_3.CyCl$. (Martius.) EtCy.CyCl.
$Fe_2Cl_3.CyCl$.†
$Ti\,Cl_4.CyCl$.

London, Feb. 24, 1870.

ON THE

CONTINUITY OF THE GASEOUS AND LIQUID STATES OF MATTER.*

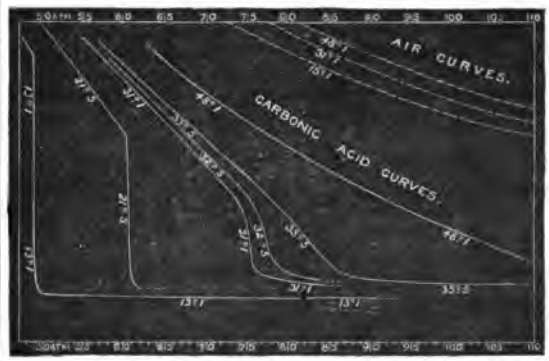
By THOMAS ANDREWS, M.D., F.R.S.,
Vice-President of Queen's College, Belfast.

(Concluded from p. 103).

At the pressure of 48·89 atmospheres, as measured by the contraction of the air in the air-tube, liquefaction began. This point could not be fixed by direct observation, inasmuch as the smallest visible quantity of liquid represented a column of gas at least 2 or 3 m.m. in length. It was, however, determined indirectly by observing the volume of the gas 0·2° or 0·3° above the point of liquefaction, and calculating the contraction the gas would sustain in cooling down to the temperature at which liquefaction began. A slight increase of pressure was required even in the early stages to carry on the process. Thus the air-guage, after all reductions were made, indicated an increase of pressure of about one-fourth of an atmosphere (from 48·49 to 49·15 atmospheres) during the condensation of the first and second thirds of the carbonic acid. According to theory, no change of volume ought to have occurred. This apparent anomaly is explained by the presence of the trace of air (about 1-500th part) in the carbonic acid to which I before referred. It is easy to see that the increase of pressure shown in these experiments is explained by the presence of this small quantity of air. If a given volume of carbonic acid contain 1-500th of air, that air will be diffused through a space 500 times greater than if the same quantity of air were in a separate state. Compress the mixture till 50 atmospheres of pressure have been applied, and the air will now occupy, or be diffused through, ten times the space it would occupy if alone and under the pressure of one atmosphere; or it will be diffused through the space it would occupy, if alone and under the pressure of 1-10th of an atmosphere. While the carbonic acid is liquefying, pressure must be applied in order to condense this air; and to reduce it to one-half its volume, an increase of 1-10th of an atmosphere is required. The actual results obtained by experiment approximate to this calculation. From similar considerations, it follows that if a mixture of air and carbonic acid be taken, for example in equal volumes, the pressure, after liquefaction has begun, must be augmented by several atmospheres, in order to liquefy the whole of the carbonic acid. Direct experiments have shown this conclusion to be true.

The small quantity of air in the carbonic acid disturbed the liquefaction in a marked manner, when nearly the whole of the carbonic acid was liquefied, and when its volume relatively to that of the uncondensed carbonic acid was considerable. It resisted for some time absorption by the liquid, but on raising the pressure to 50·4 atmospheres it was entirely absorbed. If the carbonic acid had been absolutely pure, the part of the curve for 13·1° representing the fall from the gaseous to the liquid state, would doubtless have been straight throughout its entire course, and parallel to the lines of equal pressure.

FIG. 4.



The curve representing the results at 21·5° agrees in general form with that for 13·1°, as shown in the above figure. At 13·1°, under a pressure of about 49 atmospheres, the volume of carbonic acid is little more than three-fifths of that which a perfect gas would occupy under the same conditions. After liquefaction, carbonic acid yields to pressure much more than ordinary liquids; and the compressibility appears to diminish as the pressure increases. The high rate of expansion by heat of liquid carbonic acid, first noticed by Thilorier, is fully confirmed by this investigation.

The next series of experiments was made at the temperature of 31·1°, or 0·2° above the point at which, by compression alone, carbonic acid is capable of assuming visibly the liquid form. Since I first announced this fact in 1863, I have made careful experiments to fix precisely the temperature of this critical point in the case of carbonic acid. It was found in three trials to be 30·92° C., or 87·7° F. Although for a few degrees above this temperature a rapid fall takes place from increase of pressure, when the gas is reduced to the volume at which it might be expected to liquefy, no separation of the carbonic acid into two distinct conditions of matter occurs, so far as any indication of such a separation is afforded by the action of light. By varying the pressure or temperature, but always keeping above 30·92°, the great changes of density which occur about this point produce the flickering movements I formerly described, resembling in an exaggerated form the appearances exhibited during the mixture of liquids of different densities, or when columns of heated air ascend through colder strata. It is easy so to adjust the pressure that one-half of the tube shall be filled with uncondensed gas and one-half with the condensed liquid. Below the critical temperature this distinction is easily seen to have taken place, from the visible surface of demarcation between the liquid and gas, and from the shifting at the same surface of the image of any perpendicular line placed behind the tube. But above 30·92° no such appearances are seen, and the most careful examina-

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* Wöhler (*Ann. der Chem. und Pharm.*, vol. lxxiii., p. 226).
† Klein (*Ann. der Chem. und Pharm.*, vol. lxxiv., p. 86).
‡ Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 280).
* The Bakerian Lecture for 1869, delivered before the Royal Society. Communicated to the CHEMICAL NEWS, and revised by the author.

tion fails to discover any heterogeneity in the carbonic acid, as it exists in the tube.

The graphical representation of these experiments, as shown in Fig. 4, exhibits some marked differences from the curves for lower temperatures. The dotted lines in the figure represent a portion of the curves of a perfect gas (assumed to have the same volume at 0° and under one atmosphere as the carbonic acid) for the temperatures of 13·1°, 31·1°, and 48·1°. The volume of the carbonic acid at 31·1°, it will be observed, diminishes with tolerable regularity, but much faster than according to the law of Mariotte, till a pressure of about 73 atmospheres is attained. The diminution of volume then goes on very rapidly, a reduction to nearly one-half taking place, when the pressure is increased from 73 to 75 atmospheres, or only by 1-37th of the whole pressure. The fall is not, however, abrupt as in the case of the formation of the liquid at lower temperatures, but a steady increase of pressure is required to carry it through. During this fall, as has already been stated, there is no indication at any stage of the process of two conditions of matter being present in the tube. Beyond 77 atmospheres carbonic acid at 31·1° yielded much less than before to pressure, its volume having become reduced nearly to that which it ought to occupy as a liquid at the temperature at which the observations were made.

The curve for 32·5° (Fig. 4) resembles closely that for 31·1°. The fall is, however, less abrupt than at the latter temperature. The range of pressure in the experiments at 35·5° extends from 57 to above 107 atmospheres. The fall is here greatly diminished, and it has nearly lost its abrupt character. It is most considerable from 76 to 87 atmospheres, where an increase of one-seventh in the pressure produces a reduction of volume to one-half. At 107 atmospheres the volume of the carbonic acid has come almost into conformity with that which it should occupy, if it were derived directly from liquid carbonic acid, according to the law of the expansion of that body for heat.

The curve for 48·1 is very interesting. The fall shown in the curves for lower temperatures has almost, if not altogether, disappeared, and the curve itself approximates to that which would represent the change of volume in a perfect gas. At the same time the contraction is much greater than it would have been if the law of Mariotte had held good at this temperature. Under a pressure of 109 atmospheres, the carbonic acid is rapidly approaching to the volume it would occupy if derived from the expansion of the liquid; and if the experiment had not been interrupted by the bursting of one of the tubes, it would doubtless have fallen into position at a pressure of 120 or 130 atmospheres.

I have not made any measurements at higher temperatures than 48·1°; but it is clear that, as the temperature rises, the curve would continue to approach to that representing the change of volume of a perfect gas.

I have frequently exposed carbonic acid, without making precise measurements, to much higher pressures and have made it pass, without break or interruption, from what is regarded by every one as the gaseous state, to what is, in like manner, universally regarded as the liquid state. Take, for example, a given volume of carbonic acid gas at 50° C., or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In this process its volume will steadily diminish as the pressure augments, and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it. When the full pressure has been applied, let the temperature be allowed to fall till the carbonic acid has reached the ordinary temperature of the atmosphere. During the whole of this operation no breach of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume or sudden evolution of heat, it ends with a liquid. The closest observation fails to discover anywhere indications of a change of condition in the carbonic acid, or evidence, at any period of the process, of part of it being in one physical state and part in another. That the gas has actually changed into a liquid would, indeed, never have been suspected, had it not shown itself to be so changed by entering into ebullition on the removal of the pressure. For convenience, this process has been divided into two stages, the compression of the carbonic acid and its subsequent cooling; but these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling, that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to 31°.

We are now prepared for the consideration of the following important question. What is the condition of carbonic acid when it passes, at temperatures above 31°, from the gasous state down to the volume of the liquid, without giving evidence at any part of the process of liquefaction having occurred? Does it continue in the gaseous state, or does it liquefy, or have we to deal with a new condition of matter? If the experiment were made at 100°, or at a higher temperature, when all indications of a fall had disappeared, the probable answer which would be given to this question is that the gas preserves its gaseous condition during the compression; and few would hesitate to declare this statement to be true, if the pressure, as in Natterer's experiments, were applied to such gases as hydrogen or nitrogen. On the other hand, when the experiment is made with carbonic acid at temperatures a little above 31°, the great fall which occurs at one period of the process would lead to the conjecture that liquefaction had actually taken place, although optical tests carefully applied failed at any time to discover the presence of a liquid in contact with a gas. But against this view it may be urged with great force, that the fact of additional pressure being always required for a further diminution of volume, is opposed to the known laws which hold in the change of bodies from the gaseous to the liquid state. Besides, the higher the temperature to which the gas is compressed, the less the fall becomes, and at last it disappears.

The answer to the foregoing question, according to what appears to me to be the true interpretation of the experiments already described, is to be found in the close and intimate relations which subsist between the gaseous and liquid states of matter. The ordinary gaseous and ordinary liquid states are, in short, only widely separated forms of the same condition of matter, and may be made to pass into one another by a series of gradations so gentle that the passage shall nowhere present any interruption or breach of continuity. From carbonic acid as a perfect gas to carbonic acid as a perfect liquid, the transition we have seen may be accomplished by a continuous process, and the gas and liquid are only distant stages of a long series of continuous physical changes. Under certain conditions of temperature and pressure, carbonic acid finds itself, it is true, in what may be described as a state of instability, and suddenly passes, with the evolution of heat, and without the application of additional pressure or change of temperature, to the volume, which by the continuous process can only be reached through a long and circuitous route. In the abrupt change which here occurs, a marked difference is exhibited, while the process is going on, in the optical and other physical properties of the carbonic acid which has collapsed into the smaller volume, and of the carbonic acid not yet altered. There is no difficulty here, therefore, in distinguishing between the liquid and the gas. But in other cases the distinction cannot be made; and under many of the conditions I have described it would be vain to attempt to assign carbonic acid to the liquid rather than the gaseous state. Carbonic acid, at the temperature of 35·5°, and under a pressure of 108 atmospheres, is reduced to 1-430th of the volume it occupied under a pressure of one atmosphere; but if any one ask whether it is now in the gaseous or liquid state, the question does not, I believe,

admit of a positive reply. Carbonic acid at 35·5°, and under 108 atmospheres of pressure, stands nearly midway between the gas and the liquid; and we have no valid grounds for assigning it to the one form of matter any more than to the other. The same observation would apply with even greater force to the state in which carbonic acid exists at higher temperatures and under greater pressures than those just mentioned. In the original experiment of Cagniard de la Tour, that distinguished physicist inferred that the liquid had disappeared, and had changed into a gas. A slight modification of the conditions of his experiment would have led him to the opposite conclusion, that what had been before a gas was changed into a liquid. These conditions are, in short, the intermediate states which matter assumes in passing, without sudden change of volume, or abrupt evolution of heat, from the ordinary liquid to the ordinary gaseous state.

In the foregoing observations I have avoided all reference to the molecular forces brought into play in these experiments. The resistance of liquids and gases to external pressure tending to produce a diminution of volume, proves the existence of an internal force of an expansive or resisting character. On the other hand, the sudden diminution of volume, without the application of additional pressure externally, which occurs when a gas is compressed, at any temperature below the critical point, to the volume at which liquefaction begins, can scarcely be explained without assuming that a molecular force of great attractive power comes here into operation, and overcomes the resistance to diminution of volume, which commonly requires the application of external force. When the passage from the gaseous to the liquid state is effected by the continuous process described in the foregoing pages, these molecular forces are so modified as to be unable at any stage of the process to overcome alone the resistance of the fluid to change of volume.

The properties described in this communication, as exhibited by carbonic acid, are not peculiar to it, but are generally true of all bodies which can be obtained as gases and liquids. Nitrous oxide, hydrochloric acid, ammonia, sulphuric ether, and sulphuret of carbon, all exhibited, at fixed pressures and temperatures, critical points, and rapid changes of volume with flickering movements, when the temperature or pressure was changed in the neighbourhood of those points. The critical points of some of these bodies were above 100°; and in order to make the observations, it was necessary to bend the capillary tube before the commencement of the experiment, and to heat it in a bath of paraffin or oil of vitrol.

The distinction between a gas and vapour has hitherto been founded on principles which are altogether arbitrary. Ether in the state of gas is called a vapour, while sulphurous acid in the same state is called a gas; yet they are both vapours, the one derived from a liquid boiling at 35°, the other from a liquid boiling at −10°. The distinction is thus determined by the trivial condition of the boiling point of the liquid, under the ordinary pressure of the atmosphere, being higher or lower than the ordinary temperature of the atmosphere. Such a distinction may have some advantages for practical reference, but it has no scientific value. The critical point of temperature affords a criterion for distinguishing a vapour from a gas, if it be considered important to maintain the distinction at all. Many of the properties of vapours depend on the gas and liquid being present in contact with one another; and this, we have seen, can only occur at temperatures below the critical point. We may accordingly define a vapour to be a gas at any temperature under its critical point. According to this definition, a vapour may, by pressure alone, be changed into a liquid, and may therefore exist in presence of its own liquid; while a gas cannot be liquefied by pressure, that is, so changed by pressure as to become a visible liquid distinguished by a surface of demarcation from the gas. If this definition be accepted, carbonic acid will be a vapour below 31°, a gas above that temperature; ether, a vapour below 200°, a gas above that temperature.

We have seen that the gaseous and liquid states are only distant stages of the same condition of matter, and are capable of passing into one another by a process of continuous change. A problem of far greater difficulty yet remains to be solved, the possible continuity of the liquid and solid states of matter. The fine discovery made some years ago by James Thomson, of the influence of pressure on the temperature at which liquefaction occurs, and verified experimentally by Sir W. Thomson, points, as it appears to me, to the direction this inquiry must take: and in the case at least of those bodies which expand in liquefying, and whose melting points are raised by pressure, the transition may possibly be effected. But this must be a subject for future investigation; and for the present I will not venture to go beyond the conclusion I have already drawn from direct experiment, that the gaseous and liquid forms of matter may be transformed into one another by a series of continuous and unbroken changes.

ON THE

ACTION OF SODIUM ON ACETIC ETHER.

By J. ALFRED WANKLYN.

IN reply to Frankland and Duppa's note on this subject, read before the Royal Society on Thursday last, I wish to point out that, in addition to the obvious source of fallacy arising from the presence of alcohol in the acetic ether taken for experiment, there is another fallacy depending upon the production of alcohol by secondary action during the course of the experiment. This secondary action consists in the now well-known reaction between acetic ether and ethylate of sodium, whereby acetate of ethylene-sodium and alcohol are formed. If the details of Frankland and Duppa's paper be examined, it will be found that they have given no adequate proof of the original purity of the acetic ether employed by them, and that they have operated under conditions eminently favourable for the production of alcohol by action of acetic ether on the ethylate of sodium, which is an admitted product of the action of sodium on the ether. The high temperature (130° C. they tell us) and the great length of time taken for the experiment, viz., several days, afford these favourable conditions.

I have no doubt that every trace of hydrogen obtained by Frankland and Duppa proceeded from alcohol.

The explanation which these chemists have offered in order to account for my not getting hydrogen, will, I think, not find general acceptance. In the instance of acetate of amyl, which did not give a trace of gas, I operated under little more than ordinary atmospheric pressure, for this ether boils at 140° C., and I heated only to 100° C. And, finally, I found that potassium dissolves without effervescence in pure acetic ether contained in an open vessel at ordinary atmospheric pressure. In 1840, Löwig published a similar assertion on the action of potassium on acetic ether.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 101).

LESSON II.

Material for Examination—Dirt from Sponges.

THIS can be obtained in any quantity from dealers. It accumulates at the bottom of the boxes in which sponge is imported.

Arrange the microscope as in the former lesson, O2, Illuminator. PARABOLIC LIEBERKUHN or [*Con-*

densing-Lens].—If artificial light is used, render the rays parallel (vol. xx., p. 255) before they are reflected from the lieberkuhn.

Spread a small portion of the substance over the stage-plate.

The specimen will most likely be found to consist chiefly of sand, which prevents a good view of the other substances in it being obtained, although, here and there, some objects may be seen. The sand may be removed by sifting through a piece of wire-gauze, of about 40—50 threads to the inch; or a series of sieves may be used, if it is wished to carry out the sorting to a greater extent. Examine some of the coarse residue as before. The principal contents will be coarse sand and fragments of rock, fibre, abraded splinters of wood, seaweed, fragments of *Echinus* spines, skeletons of various *Hydrozoa* and *Polyzoa* (vulg., *Zoophytes*), sponge, spicules, and shells.

Separate the shells and other objects that may be required for further study; this may be done by picking them up with a small camel-hair pencil, moistened and drawn to a point. Small pill-boxes or homœopathic-bottles make convenient receptacles for keeping these objects in, when sorted. A pocket-lens mounted on a stand, or a watchmaker's glass will afford sufficient magnifying power. If the light is concentrated upon the substance to be examined with the condensing-lens, and black paper used to spread the sand on, a great deal may be done without using the glass at all. For dissecting and more delicate operations of this kind, Beck's 3-inch binocular magnifier will be found useful: it is, in effect, a pair of achromatic spectacles of considerable power, and fatigues the eyes less in prolonged operations than the use of a single lens. A more complete binocular dissecting is described in "Carpenter," p. 54.

Select some of the shells resembling small nautili (*Foraminiferæ*), and make arrangements for examining them in varied positions with Disc-holder (vol. xx., p. 193) or [*stage-forceps*]. Observe the peculiar structure of the part where the mouth of an ordinary univalve-shell (*Gasteropoda*) usually is, closed with a perforated plate, instead of being open. Also, in some species, perforations will be observed on the sides of the shells: hence the name of the group *Foraminiferæ*. Mount some of the shells dry in various positions (taking especial care that the mouth is well displayed), label, and preserve for reference.

Bed some of the shells in balsam (vol. xx., p. 208), and grind away the surface so as to expose the interior; carefully polish, and remove the balsam. This process will reveal the chambered internal structure, which varies extremely in different species. An increase of power may now be used with advantage (O1, or O½ if the illuminator for this higher objective is accessible). With such augmented power, the minute shell-structure may be observed; but this can be accomplished more readily by grinding a thin section, which will admit of examination with higher powers and the paraboloid or achromatic condenser. These thin sections can be ground by a process devised by Dr. Wallich (*Ann. Nat. Hist.*, July, 1861; also "Carpenter," p. 192, note). The shell is to be fastened to a thin plate of mica, in the first instance, and this, with the shell upwards, is to be cemented to the plate of glass on which it is held during the process. One side is ground and polished in the usual manner. The slide is then warmed, which permits the removal of the mica plate with the half-finished section attached. The shell is then cemented by its polished side to another grinding-plate, and completed in the usual manner. The plate of mica is easily ground away, and offers no impediment to the cutting of the shell. The resulting section is be mounted, either dry or in balsam, as circumstances may require.

Foraminiferæ and other shells abound in deep-sea soundings. As usually obtained from this source, they are mixed with the tallow placed at the bottom of the lead to bring up the sample: this grease must be removed by solution in benzol. *Foraminiferæ* and other fossils may be separated from chalk by processes described in Lesson 3.

For further information respecting the *Foraminiferæ*, see art. *Foraminiferæ*, "Micrographic Dictionary," p. 292; "Carpenter," pp. 482—523; Greene's "Manual of the Protozoa"; Williamson and Carpenter's Monographs (Ray Society).

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

March 3rd, 1870.

Dr. A. W. Williamson, F.R.S., &c., President, in the Chair.

Mr. C. P. Sandberg, of Stockholm, was elected a Fellow of the Society.

The first paper was by Dr. Gladstone, on "*Refraction Equivalents.*"

Three distinct lines of research had led up to the discovery of these equivalents. The first was the influence of temperature on the refraction of light by liquids; the second, the refraction of mixtures or combinations as compared with that of their constituents; and the third, the refractive indices of different members of homologous series of organic compounds. As to the first of these, it was found, by the joint labours of Dr. Gladstone and the Rev. Pelham Dale, that the refraction and the dispersion decrease as the temperature rises. Further examination showed a close relation between the change of density and the change of the refractive index minus unity, which the experimenters termed the "refractive energy," and which is expressed in the language as $n-1$. This energy, divided by the density, that is,

$$\frac{n-1}{d}$$

is called the "specific refractive energy," and is, in the case of liquids, a constant, not affected by temperature. This conclusion was subsequently confirmed by the experiments of Landolt, Wüllner, and Kühlmann. As to the second line of research (that of the refraction of mixtures, solutions, and simple combinations), Dulong attempted to show in regard to gases, and Hock in regard to some liquids, that the refractive power of a mixture is the mean of the refractive powers of its constituents. But Gladstone and Dale arrived at the conclusion that here, also, the nearest approximation to the truth was given by

$$\frac{n-1}{d};$$

and their opinion has been fully confirmed by the careful experiments of Wüllner. This general expression holds good, also, in the case of a gas or a solid in solution; and, indeed, it was expected to be so, for water, phosphorus, and sulphur have the same energies in the liquid

and solid states. The question now presented itself—Does an elementary substance retain its specific power of retarding rays when it is combined chemically with other elements? An affirmative reply was suggested by many considerations. It was, for instance, found that bromoform ($CHBr_3$) and bibromide of bromethylene ($C_2H_3Br_3$) have almost the same specific refractive energy as bromine itself.

On the other hand, however, the investigators observed that isomeric liquids were not always identical in refractive energy; and that the replacement of hydrogen by oxygen in organic compounds effected a much greater optical change in some instances than in others. Hence the conclusion was drawn that the specific refractive energy of every liquid is composed of the specific refractive energies of its component elements, modified by the manner of combination.

The third line of research was that of the refractions of different homologous compounds. The experiments of Delffs, of Landolt, and of Gladstone and Dale, have led to the view that, in all the series containing the radicles, methyl and its congeners, the specific refractive energies increase as the series advances, and that the amount of optical change is less between the higher than between the lower members of the series. Landolt, adopting Gladstone and Dale's formula for the specific refractive energy, multiplied it by the atomic weight P; and this

$$P\frac{u-1}{d}$$

he designated the "refraction-equivalent." According to this representation, the refraction-equivalent of a body is the sum of the refraction-equivalents of its constituent elements. The great advantage of this kind of expression is that it permits of the easy comparison of the optical properties of different substances. By making these comparisons, Landolt found that the refraction-equivalent of carbon is 5·0; that of hydrogen, 1·3; and that of oxygen, 3·0. Direct experiments have given figures very close to these. The way of calculating the refraction-equivalent of a compound from these data may be illustrated by ether, $C_4H_{10}O = 4(5·0) + 10(1·3) + 3·0 = 36·0$. The refraction-equivalent deduced from observation is 36·26. A great variety of liquids have given, by calculation, the same figures for the refraction-equivalents as by direct investigation. Yet there are exceptions to this agreement with theory. The whole group of the aromatic hydrocarbons and their derivatives give refraction-equivalents much above the calculated numbers. This anomaly must be due to an erroneous representation of the constitution of their nucleus, which cannot be greater than C_6H_3. However, the above method makes it possible to find the refraction-equivalents of bodies which could not otherwise be taken—for instance, of metals. The refraction-equivalents of fifty elements have been determined in this way.

It is to be remarked that the figures in the following list, which gives the refraction-values of the more important elements, represent A of the solar spectrum:—

Aluminium	8·4	Manganese	12·2—26·2
Barium ..	15·8	Mercury ..	21·3—29·0
Bromine ..	15·3—16·9	Nitrogen ..	4·1— 5·3
Calcium ..	10·4	Oxygen ..	2·9
Carbon ..	5·0	Phosphorus	18·3
Chlorine ..	9·9—10·7	Platinum ..	26·0
Chromium	15·9—23·0	Potassium	8·1
Copper ..	11·6	Silicon ..	7·5— 6·8
Hydrogen	1·3— 3·5	Silver ..	13·5
Iodine ..	24·5—27·2	Sodium ..	4·8
Iron	12·0—20·1	Sulphur ..	16·0
Lead ..	24·8	Tin	27·0—19·2
Magnesium	7·0	Zinc	10·2

It will be seen that some of the elements have a double value; and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12·0; in the ferric salts, 20·1; and, since the refraction-equivalent of iron in potassic ferridcyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts. Great anomalies present themselves in the case of oxygen. Its equivalent, in many compounds, is 2·9; but, in others, it comes down to 2·1; and, in some cases, as in some sulphates and phosphates, it would seem to be a negative quantity. This points to the conclusion that oxygen has the power of greatly modifying the action on light of those bodies with which it is combined in a high proportion.

On looking over the above list, one is struck by the identity of the equivalents of those elements which have the same, or nearly the same, atomic weight. This property is still more prominent when the specific refractive energies of the elements, instead of their refraction-equivalents, are considered. The following pairs may serve as illustration:—

Iron	0·214	Aluminium	0·307
Manganese	0·222	Chromium	0·305
Bromine	0·191		
Iodine ..	0·193		

But the most suggestive comparison is that between the specific refractive energy and the combining proportions of those metals that form salts not decomposable by water. By combining proportion is meant the actual amount which will combine with a certain quantity of a salt radicle. A few of these metals may be quoted:—

	Specific refractive energy.	Combining proportion.
Hydrogen ..	1300 ..	1
Aluminium ..	307 ..	9·1
Calcium	260 ..	20
Iron	214 ..	28
Sodium	209 ..	23
Potassium ..	207 ..	39·1
Copper	183 ..	31·7
Silver	125 ..	108
Lead	120 ..	103.5
	&c.	

The regularity in the decrease of the numbers in the first column, and the corresponding increase in the second column, would suggest that the combining proportions of silver, lead, &c., ought to be halved, in order to bring those elements to about their right places in the list. There is, further, a remarkable coincidence between the power of a metallic element to refract the rays of light and its power to saturate the affinities of other bodies (of course, it must be borne in mind that a small combining proportion means a high saturating power).

Dr. THUDICHUM made a communication "*On Kryptophanic Acid*," a normal ingredient of human urine.

The substance can be obtained in various ways from the primary material. One is to treat the urine with an excess of milk of lime to concentrate the mixture, filter it from the gypsum to acidify the filtrate, and evaporate it to syrupy consistency. This syrup, after having been filtered from the salt-cake, is treated with strong alcohol, which separates the lime-salt of the kryptophanic acid as a dark, flaky mass. The impure lime-salt is dissolved in water, and mixed with a solution of neutral lead-acetate: a dark-coloured precipitate is formed, from which the mother liquor is filtered. The filtrate, containing lead-kryptophanate, is treated with strong alcohol, whereupon white lead-kryptophanate is deposited in flakes, from which the acid is liberated by sulphuretted hydrogen.

Kryptophanic acid is an amorphous, gummy mass, transparent, and nearly colourless. It forms salts with the alkalies, the alkaline earths, and many metals. In the aqueous solutions of its earthy salts, a precipitate is produced by mercuric nitrate (the ordinary analysis for urea by this reagent is thus shown to be liable to error). The determinations of the free acid, as well as of its salts, have led to the formula $C_5H_9NO_5$, and shown the acid to be dibasic; in some cases, however, it may be taken as tetrabasic, and then its formula would be $C_{10}H_{18}N_2O_{10}$.

For the next meeting, on March 17th, the following papers are announced:—"On Artificial Alizarine," by W. H. Perkin, F.R.S.; and, "On the Combinations of Carbonic Acid with Ammonia and Water," by Dr. Divers.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 22, 1870.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President in the Chair.

THE PRESIDENT referred to the observations he had made in former years on the progressive rise of the freezing point of one of his thermometers, published in the Proceedings for April 16, 1867. He had made a further observation on the 12th February inst., and found that a rise, which though very small was unmistakable, was still taking place after a lapse of time of 26 years since the bulb was blown. The results are as follow in indications of the thermometer, calling the first observation in April, 1844, zero. 12·9 divisions of the thermometer correspond to one degree Fahrenheit.

April,	1844	0
Feb.,	1846	5·5
Jan.,	1848	6·6
Feb.,	1853	8·8
April,	1856	9·5
Dec.,	1860	11·1
March,	1867	11·8
Jan.,	1868	11·92
Feb.,	1870	12·02

Dr. F. CRACE CALVERT, F.R.S., stated that he did not intend to read a paper on *artificial alizarine*, some of the facts he was going to bring before the notice of the meeting being well known to his colleagues, the chemists of this district, but he hoped it might be interesting to the general members of the Society to have an idea of the progress that had been made during the last few months in the production of this substance. They were aware that alizarine was the essential colour-giving principle of the madder root. Every cultivated mind in Lancashire ought to be acquainted with each step made in the artificial production of this dye, owing to the immense capital involved in the cultivation of the madder plant in the working of it up in this country, as well as the revolution it will effect in our commercial relations and the important new branches of manufacture it will create.

It was well known to the members of this Society that about 12 months ago Messrs. Graebe and Liebermann had discovered a method of producing alizarine from a coal-tar product, which up to that time had attracted very little attention, even in the scientific world, viz., anthracene, $C_{14}H_{10}$, and that by oxidation they transformed it into anthraquinone, $C_{14}H_8O_2$, which in turn was changed into bibrom-anthraquinone, $C_{14}H_6B_2O_2$, this being converted into alizarine, $C_{14}H_8O_4$, by the addition of two equivalents of oxygen and the formation of two equivalents of hydrobromic acid.

It was felt by all chemists that this discovery was one of great importance, though it was too complicated to be commercially useful, but the Gordian knot being now cut, the commercial production of artificial alizarine was merely a question of time, and what he would now relate showed the marked progress which had been made toward this end.

There were already three patents published; and one process, the details of which are kept secret, is being worked by Messrs. Meister, Lucius, and Co., of Hœchst, near Frankfort. The patents are those of Messrs. Brœnnan and of Gutzkow, of Messrs. Caro, Graebe, and Liebermann, and Mr. W. H. Perkin. It was curious to notice that the patent of Messrs. Caro was dated the 25th of June last, and Mr. Perkin's the 26th of the same month; and that all these patents effect the same purpose by simply employing different oxidising agents. Messrs. Brœnnan and Gutzkow oxidise the anthracene into anthraquonine by means of the nitrate of protoxide of mercury, Messrs. Caro by peroxide of manganese, and Mr. Perkin employs oxanthracene, and then all by further processes, which are nearly the same, convert anthraquinone into alizarine.

As it might be interesting to many of the members to have an outline of one of the methods employed, he would therefore describe a process detailed in the specification of Messrs. Caro, Graebe, and Liebermann. One part of anthracene is heated with four of sulphuric acid, of specific gravity 1·845, for three or four hours, to a temperature of 212° F., and then for about an hour at 300°. The mixture is allowed to cool, and to it is added water equal to three times the weight of the anthracene employed, and manganese equal to four times that weight.

The whole is boiled for three hours and milk of lime added, which gives rise to a deposit consisting of the excess of lime and manganese used and protoxide of manganese, while there remains in solution a double sulphate of anthraquinone and lime. This solution is now acted on by carbonate of soda in slight excess, carbonate of lime separates, and the salt of soda thus produced is evaporated to dryness. This solid mass is then mixed with two or three parts of caustic potash or soda and a small quantity of water, and the whole heated under pressure in suitable vessels at a temperature of 350° to 500° F. for one hour, when the anthraquinone is further oxidised, and converted into alizarine. The alkaline mass, on cooling, is dissolved in water, and sulphuric or acetic acid added in slight excess, when an orange-yellow, flocculent substance precipitates, which, when properly washed and dried, is artificial alizarine.

If this process can be carried out on a practical scale (and there is no doubt that it will be, under the direction of such clever chemists as Messrs. Perkin, Caro, and others), we may then fairly consider the production of artificial alizarine as having reached the sphere of commercial application; though I may add, from personal experience, that some time must elapse before it can be manufactured in quantities sufficient to affect the present applications of madder, garancine, Schunck's commercial alizarine, &c.

There is another great difficulty yet to be overcome before the artificial alizarine can become a commercial article, that is, the obtaining of anthracene in larger quantities, and this question is of some importance to us, England being the great tar producing country. Anthracene does not appear to exist in greater proportion than one in a thousand of tar, and is only liberated or produced during the latter part of the distillation of the tar. In fact, if the distillation be stopped so as to leave a very soft pitch, the oils obtained give little or no anthracene. If, on the other hand, it is carried on so as to get 10 or 15 per cent more oil off, there remains a hard pitch which has little or no value at the present day, the quantity of anthracene obtained varying very much according to the nature of the coals employed in the production of the tar, ranging from 1½ to 8 per cent of the heaviest oils separated; it will scarcely be worth the while of the tar distiller to depreciate the value of one of the staple articles of his trade to produce it, and even when the heavy oil is obtained the separation of the small quantity of anthracene it contains, and its purification for use according to the above patents, will yet require much time and research. It is well known to all who have worked on the coal-tar products that each well-defined compound is mixed with homologues which renders its separation and purification a work of extreme difficulty; thus aniline is mixed with picoline and several other alkaloids, benzol with toluol and other hydrocarbons,

carbolic acid with cresylic and other acids, and anthracene is also mixed in a similar manner with homologous compounds.

The mere distillation and filtration of the solids obtained and their hot or cold pressing, or even their sublimation, do not effect the complete purification of the substance. The purest product I have been able to obtain on a moderate commercial scale has contained, when cold pressed about 40 per cent, and when hot pressed about 70 per cent of anthracene. One of the chief difficulties in its preparation is the fact of its great solubility in its liquid homologues at a moderate temperature, thus an oil, at 40° or 45° F., will yield a comparatively large quantity of anthracene by filtration, but if its temperature be raised to 70° or 80°, the anthracene will be completely dissolved.

I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coaking it, but the expense, difficulty, and danger of such an operation are such that I doubt if they can be overcome so as to produce anthracene of comparative purity on a commercial scale.

Papers have been published respecting the identity of the alizarine produced by the process of Messrs. Meister, Lucius, and Co., with natural alizarine, by Dr. Schunck, Professor Bolley, and Messieurs Emile Kopp, Camille Kœchlin, La Fraisse, G. Wallace Young, and J. Christie. The opinions of these chemists vary. Dr. Schunck and Professor Bolley consider it identical, the other gentlemen considering it not identical, some of them maintaining it to be a mixture of purpurine and alizarine.

The product made according to the patents mentioned I have not had an opportunity of examining, nor have I seen any papers on the subject in any of the scientific journals which have reached my hands; but as doubtless it will shortly be before the public, I shall take an early opportunity of laying before the society the results of my own experience as well as those of others.

In conclusion, I think many years must elapse before artificial alizarine can replace madder and its preparations in all their varied applications in calico printing, but ere long the purity of the substance, artificially obtained, may prove of great service to the calico printer, by enabling him to produce, at a cheaper rate than now, certain styles of prints as well as new styles and effects.

Specimens or anthracene, artificial alizarine, and dye fabrics were exhibited.

Dr. Schunck, F.R.S., remarked that the practical success of the new process would in a great measure depend on the price of the raw material, anthracene, and on the amount of colouring matter to be obtained from it. The process itself was, however, as far as the few experiments he had made allowed him to judge, a very simple and easy one, requiring the use of no costly materials. He was convinced himself that the artificial product was identical with the natural alizarine of madder, the only difference being that the former was generally contaminated with some impurity which prevented its crystallising easily. Purpurine was not formed along with alizarine, as had been supposed. He also exhibited to the meeting some specimens of Turkey-red dyed with artificial alizarine, which had been sent to him by Mr. Perkin, and stated that the latter had already manufactured several tons of the new product.

In connection with this subject Dr. Schunck referred to a notice contained in the Chemical News (vol. xxi., p. 81), giving an account of a process for preparing pure alizarine from Turkey-red dyed cotton. The author, M. Schützenberger, does not state that the process is new, though he seems to claim it as his own. Almost the same process was, however, described many years ago by Dr. Schunck, who claims, indeed, to have been the first to point out that Turkey-red, madder pink, and all the finer madder colours are simply compounds of alizarine and fatty acids with bases. The experiments on which this conclusion was founded were described in the edition of "Ure's Dictionary of Arts," published in 1859, under the heads of "Madder" and "Turkey-red," but the experiments themselves were made at a much earlier date.

(To be continued.)

NOTICES OF BOOKS.

A Dictionary of Scientific Terms. By P. Austin Nuttall, LL.D., Editor of "The Classical and Archæological Dictionary," "Standard Pronouncing Dictionary," and numerous educational works. London: Strahan and Co., 1869. 8vo.; pp. 325.

The object of this work is "to render the language of science intelligible not only to the professional student but to the general reader." It has been specially arranged with a view to educational purposes, and to further the working of the revised code which was framed a short time ago by the Committee of the Council for Education. Dr. Nuttall's book is dedicated "By special permission to the Right Honourable Robert Lowe, Chancellor of Her Majesty's Exchequer, and the eloquent representative of University *College* (*sic?*), London." Now, the Right Honourable Robert Lowe is not only Chancellor of Her Majesty's Exchequer, but Master of Her Majesty's Mint, and in these combined capacities he is at this moment preparing a Bill to consolidate and amend the laws relating to the coinage and the Mint. With such a subject, what can be more natural than that he should turn for some piece of technical or scientific information to the work so recently, and "by special permission" dedicated to him, and of which it may be reasonable to suppose he possesses an elaborately bound and large-paper copy? He seeks for—what shall we say? —*metals*, as most *apropos* to his new position, and at page 17 of the introduction, he reads, "A few of the principal metals are here given in alphabetical order:—

Antimony.	Copper.	Manganese.	Silver.
Arsenic.	Gold.	Mercury.	Steel.
Bismuth.	Iridium.	Nickel.	Tin.
Black-lead.	Iron.	Ochre.	Tungsten.
Brass.	Lead.	Pewter.	Zinc."
Cobalt.	Magnet.	Platinum.	

"I had no idea," muses the Right Honourable gentleman, "that black-lead and ochre were reckoned among the principal metals, but science is making wonderful strides now-a-days." Next he specialises, and turns to gold, silver, copper. Gold is found to be "the most valuable and ductile of all the metals, and is used by all civilised nations as a standard of value;" it "unites with most other metals, and with sulphur, ammonia, &c." "Silver is one of the fifty-five simple or elementary bodies, and included in the sub-division termed metals nearly white." "The ores of copper are very numerous, the principal being sulphuret of copper and iron (iron pyrites), and sulphuret of copper (nitrous copper ore)." Let us sincerely hope (and, if necessary, memorialise the Right Honourable gentleman on the subject) that Mr. Lowe will not ordain this the text-book of the Treasury, will not have it employed by candidates for Civil Service appointments, will not get up his chemistry and metallurgy and general science from it. Now, if a new or modified code of taxes were framed on its authority, we do not know what would become of us, had we not Dr. Playfair in the House to see fair play in regard to all that relates to *scientia immutabilis*.

Now we fully recognise and admit the difficulty and labour of compiling such a work as that before us. We wish to make every allowance for this difficulty, and we assure Dr. Nuttall we would always rather praise than blame. If his soul be in law or literature, while his body, for the time being, is in science (like the man in the old Spanish song whose body was in Segovia while his soul was in

Madrid), we have the more sympathy for him. He has told us in the preface that "occasional omissions or oversights may possibly be discovered," and he has asked "every indulgence from generous public." We will respect this; it may be thought we have been seeking omissions and errors; now on our word of honour we will open the book several times at random, with our eyes shut, and thereupon criticise without favour and with eyes open. "CRATER, the mouth of a volcano. In *astrology*, a constellation in the southern hemisphere. CRETINISM a species of *idiotism* with which the goitrous inhabitants of the alpine valleys are afflicted." FLUORIC ACID = 3 atoms of fluorine + 1 of boron, equiv. 66·98." (The last example p. 154, left-hand column). "CHLORIDE OF POTASH, a valuable compound prepared by passing chlorine gas into a mixture of 1 lb. of caustic lime, and 1 lb. of potash, with 8 lbs. of water." O! Dr. Nuttall, hard worker and earnest though you may be, we must tell you that this is not the science of to-day. We do not quote Werner for geology, Hoblyn for chemistry, Howard for meteorology, Craig for mathematics, or "the intelligent author of "The Traveller's Remembrancer," for anything whatsoever. We neither know their names, nor recognise their authority. We do not use such terms as *hydroguret*, *electrology*, *fluate of lime*, *hydropneumatic*, *physicologist*, no do we include hydrostatics in hydrodynamics (p. 184). This is partly the science of another age, partly the science of no age at all.

And now, before leaving the work, let us return once more to the introduction. It is headed by what we suppose is the key-note of the work, the phrase which Colonel Newcome loved to quote, which the Padre Cura of Guadarrama persisted in attributing to Cicero, and which comes to most of us at an early age *viâ* the latin grammar, and the syntax therein, and the troublesome nominative to the verb:—

> "Didicisse fideliter artes
> Emollit mores, nec sinit esse feros."

But why has our author omitted the "*Ingenuas?*" Injured shade of Ovid, you have our sympathy. Are not the arts of which he treats ingenuous? We feel bound to confess that they could not be learnt faithfully from the work before us if they were, so perhaps it is as well to maim the lines altogether; and we would further (with apologies to the reader) state that the learning of the arts, especially those appertaining to the extracts given above, out of this book has quite a reverse effect to that conveyed by the Ovidian maxim, for it makes us exceedingly *ferus*. Not far removed from "Didicisse, &c.," in the Latin grammar, our author may remember another phrase, which he may be inclined to say to us after perusing the above remarks: "Vos damnâstis; (*quasi dicat* prœterea nemo") but we assure him in this case the nominative of the pronoun need not be expressed; it is not we alone who have condemned; we must say *Damnaverunt* without the pronoun, and we regret it for his sake.

MISCELLANEOUS.

The Royal Society.—The president gave the first *soirée* of the season on Saturday evening last at Burlington House. There was a large attendance of visitors, and a number of objects of scientific interest were exhibited. Mr. Browning's display included an improved large automatic electric lamp, in which the carbon points are drawn asunder, and their distance regulated solely by the force of the electric current employed; transparent stereograms on glass, of a globe of the planet Mars; water-colour drawing of Jupiter, exhibiting the ochreish-yellow or tawny belt, now visible near the equator of the planet; arrangement of spark condenser, in connection with a condenser in box to take the Leyden jar, the upper part to unscrew and pack in lid of box—the advantages are perfect insulation, large surface in small space, freedom from liability to fracture, portability; bright cross micrometer for measuring the position of lines in faint spectra; by using this instrument only the cross is seen illuminated, and the light of the spectrum is unimpaired; spectrum of pure gold, shown in a chemical spectroscope, this instrument has been arranged specially for use in a laboratory, the prism is provided with a very closely fitting cover, and the prism can be removed from the plate and a prism of any other substance introduced instead, for the convenience of taking refractive indices and dispersive powers. The India Rubber Company showed the Leclanché battery. The vacuum tubes shown by Mr. Apps attracted considerable attention. Mr. Ladd showed his new form of electric lantern recently described in these columns. This maker also showed a new form of micro-spectroscope. Mr. W. Chandler Roberts, the chemist to the Mint, exhibited remarkable specimens of electro-deposited iron, prepared by M. Jacobi, of St. Petersburg, and himself. The metal is sufficiently hard to scratch glass. The application of hard iron plates for printing purposes was illustrated by some extremely fine proofs. This material possesses great advantages as an art material. Specimens of electro-iron converted into steel were also shown.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, February 21, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Cause of the Electro-Capillary Currents in the Bones, Nerves, and Brain.—E. Becquerel.—A physiologico-physical treatise.

Synthesis of Aromatic Acids.—A. Wurtz.—The substance mainly described in this paper is dibenzyl-carboxylic acid, $C_{18}H_{16}O_2$, obtained by the action of sodium upon chloride of benzyl and chlor-oxycarbonic ether, according to the following formula:—

$$2(C_7H_7Cl)+CO\left\{\begin{matrix}Cl\\O.C_2H_5\end{matrix}\right\}+3Na=3NaCl+H+C_{16}H_{18}-CO_2.C_2H_5.$$

This acid is almost insoluble in cold water, somewhat soluble in boiling water, and very readily soluble in alcohol and ether. It is a solid substance; it fuses at 84°; at a very high temperature, it boils, and distils over without alteration. The salts of this acid crystallise with difficulty; the calcium salt yields, when submitted to dry distillation along with excess of lime, a mixture of dibenzyl and stilben.

Stability of the Normal Propylic, Butylic, and Amylic Alcohols, considered as Chemical Species (Espèces Chimiques).—J. Pierre and E. Puchot.—The authors have studied chiefly—The temperature of ebullition; the specific gravity at 0°, and at various other temperatures; the index of refraction at one and the same temperature; and the action of polarised light of the substances just named. The results are given in the shape of tabulated forms.

Report on the Labours Concerning Ozone.—Aug. Houzeau.—From this very lengthy paper, we quote an almost unknown fact—viz., that, as far back as the year 1785, Dr. van Marum, at Haarlem, noticed that oxygen was curiously modified after it had been submitted for some time to the passage of electric sparks. He proved that the gas thus acted upon oxidised mercury very rapidly at the ordinary temperature of the air; and he also particularly noticed the peculiar odour the gas had acquired. The author quotes the following new method for the preparation of ozone:—Binoxide of barium is treated for this purpose with sulphuric acid; the oxygen given off is strongly ozonised. It is also observed that the presence of ozone in air, although very probable, has not been hitherto undeniably proved, while the presence in air of various other substances, among these, hyponitric acid, cannot be denied; and a great difficulty arises from the similarity of the reactions with the same reagents exhibited by these bodies. This paper is a complete monograph on ozone.

Researches on the Artificial Digestion of Amylaceous Matter by the Aid of Maltine.—L. Contaret.—Maltine is obtained from barley-malt by steeping that substance in tepid water. The substances thus extracted from malt, and collectively called maltine, or vegetable diastase, has been applied by the author for experimenting upon starchy substances, and converting these, at about 38°, and under the influence of water, into dextrine and sugar (glucose). The author's maltine is very similar to, if not identical with, the much-vaunted malt extract.

Method adopted by the late L. Foucault to Recognise whether the Surface of a Mirror is Rigorously Parabolic.—A. Martin.

A New Kind of Thermometer.—A. Lamy.—Some time ago, this author proposed a pyrometer based upon the dissociation of carbonate of lime; he now proposes to apply ammoniacal chloride of calcium, which gives off ammonia at low temperatures. The instrument is to be connected with a manometer, which will record the temperature. The contrivance is to be especially adapted to record the temperature at different depths under the surface of the soil. M. E. Becquerel and others very properly observe that better and far more accurate means for accomplishing this purpose exist already, and are daily successfully employed.

Some Observations on the Diamond Found at Diaschkowitz (Bohemia).—A. Schafaritz.—In order to settle all doubt about the true nature of this diamond, the author has burned, in a current of oxygen, and with suitably-arranged apparatus, a sufficient quantity of this stone to prove that it is completely consumed, yielding only carbonic acid. We, moreover, learn from this paper that the geological conditions of the locality where this stone has been found bears a great resemblance to the geological conditions of that portion of the Brazil where diamonds are constantly sought for.

Combination of the Hydracids with Bromated Ethylen and Propylen.—M. Reboul.

Action of the Haloids in Free State, and of some Chlorides, upon Glucose.—A. Colley.—After referring to the action of the haloids upon anhydrous glucose at a high temperature (80° to 112°), and, also, after having mentioned the influence of water and the action of hydrochloric acid upon glucose, the author describes, at great length, the action of chloride of acetyl upon this substance when placed in a sealed tube; the result is the formation of acetochlorhydrose, a solid body capable of crystallising, insoluble in water, and soluble in alcohol, ether, and chloroform. On being submitted to elementary organic analysis, results were obtained leading to the formula $C_6H_7(C_2H_3O)_4O_5Cl$. Its mode of derivation from glucose is represented by—

$$C_6H_{12}O_6+5C_2H_3OCl=C_6H_7(C_2H_3O)_4Cl+C_2H_4O_2+4HCl.$$

This formula is exactly reproduced from the original.

A New Phosphated Compound.—L. Darmstädter and A. Henninger.—While causing an ethereal solution of phosphuretted hydrogen to act upon chloride of cyanogen, the authors have obtained—

$$P\begin{cases}CN\\C_2H_5\\H\end{cases}$$

a solid substance, crystallising in rhombic-shaped crystals, fusing at about 50°, and volatilised without decomposition. This cyanethylphosphide is readily soluble in water, alcohol, and ether, and its formation is elucidated by—

$$CNCl+PH_2+(C_2H_5)_2O=CNPH(C_2H_5)+HCl+C_2H_5.OH.$$

Chemical and Therapeutical Researches of the Thermo-Mineral Water of the Solfatara of Pouzzoles (Italy).—S. De Luca.—This mineral spring, met with near Naples, is remarkable for containing arsenic, free sulphuric acid, and a number of other substances, amounting, per litre, to—Sulphuric acid (calculated in anhydrous state), 1·473 grms.; chlorine, 0·0085; protoxide of iron, 0·1105; lime, 0·101; magnesia, 0·0225; potassa, 0·017; ammonia, 0·0135; alumina, 0·335; silica, 0·315; soda, manganese, arsenic, and nitrogenised organic matter, traces. As regards the presence of arsenic, the author states that the volcanic fumarola, close to the spring, yields vapours among which the presence of sulphide of arsenic is readily made visible, by holding, for a moment, any cool substance, even paper, at the place whence they exude to obtain crystals of sulphide of arsenic. This water yields, on evaporation, excellent alum, and is therapeutically applied, internally as well as externally. The temperature is not mentioned.

February 28, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Modifications Produced by Magnetism in the Light Emitted by Rarefied Gases Enclosed in so-called Geissler Tubes.—Rev. A. Secchi, S.J.

New Studies on Propylic, Butylic, and Amylic Aldehydes.—I. Pierre and E. Puchot.—Pure propylic aldehyde is a limpid, colourless liquid, boiling at 46°; it emits a suffocating odour; is so prone to oxidation, that it is difficult to obtain it free from propionic acid; reduces nitrate of silver readily; sp. gr. at 0°, 0·8327, at 32°, 0·7906. Butylic aldehyde is also a limpid, colourless liquid, which readily reduces salts of silver, and boils at 62°; sp. gr. at 0°, 0·8226, at 27·75°, 0·7919. Amylic aldehyde, also a liquid, boils at 92·5°, and is very readily converted, by oxidation, into valerianic acid; sp. gr., at 0°, 0·822, at 4·34°, 0·779.

Determination of the Form of Our Globe by Experimental Means.—G. Lambert.

Note on the Physical Condition of Bodies.—F. Lucas.—Both these papers are physico-mathematical essays.

Observations made of a Meteorite at the Observatory at Paris.—MM. Wolff, Adré, and Capitanes.—A concise account of a meteorite seen on the 26th of February last, at 9·35 p.m.

Foucault's Method of Autocollimation, and its Application to the Study of Parabolic Mirrors.—A. Martin.

Divers Orders of Spectra of the Simple Bodies.—Dr. Dubrunfaut.

Solution of Reducing Gases by Molten Iron and Carburets of Iron when in Liquid State by Fusion.—H. Caron.—The author of this paper states that the spirting of fused cast-iron is not due, as has been stated by M. H. St. Claire-Deville, to the solution (or absorption) of certain gases in these metals while at a high temperature, but is the result of a peculiar reaction which continues until the metal is completely solidified. M. H. St. Claire-Deville replies that, whether the gas be oxide of carbon or hydrogen mixed, or whether it be oxide of carbon only, it is the gas which causes the spirting, and often even the projection, of large quantities of molten metal to great distances.

Oxidation of Iron.—F. C. Calvert.—This paper contains a full description of a series of experiments made with the view to establish precisely the causes of and conditions under which iron rusts. The author comes to the conclusion that the carbonic acid, as well as the watery vapour, contained in the atmosphere concur jointly in causing iron to rust. Prof. Chevreul makes the following observations on this subject:—Claude Bourdelin was the first who observed (in 1683) that ammonia is formed when aërated water acts upon steel. In 1720, E. F. Geoffroy found that iron rust formed in the air contains moisture and ammonia. Vanquelin found ammonia in the specks of rust formed upon a chopper, of which it was suspected that it had been used for murdering somebody; the presence of ammonia in iron rust should, therefore, be cautiously dealt with in medico-legal questions. According to Dr. Calvert, pure iron does not decompose pure water at the ordinary temperature; and if this is correct, the fact observed by Prof. Chevreul, that the white hydrated protoxide of iron decomposes water, becomes more interesting.

Dissociation of Ammoniacal Compounds.—F. Isambert.—The author describes a series of experiments made with anhydrous double salts of ammonia, zinc, and cadmium sulphates, and the dissociation of these by heat (100°), aided by vacuum. The general conclusion arrived at by the author is that, by the action of ammonia gas upon the chlorides or sulphates of the metals alluded to, there is, independently of the chemically-combined ammonia, some of that gas absorbed in the same manner as charcoal is capable of doing. The compound $CdOSO_3,3NH_3$ is to be considered as made up of $(CdOSO_3,NH_3)2NH_3$.

Aurora Borealis and other Meteorological Phenomena Seen and Observed in Piedmont on January 3rd, 1870.—Rev. P. Denza, S.J.

Cosmos, February 26, 1870.

The Newton-Pascal Forgeries.—The forger of these and other documents (a number of 27,000, only taking into account those purchased by M. Chasles, who paid £5600 for the same) is now on his trial before one of the tribunals of Paris.

Discovery of Coal in the Brazil.—R. von Brause states that he has discovered coal of very good quality in the Province of Santa Catharina, near Ararangua. The seam which crops out has been explored for a distance of some 30 miles, and found to be of an average thickness of 1 metre. This coal has been thoroughly tested and analysed by Dr. Netto, of Rio de Janeiro, and is interesting as one of the very few instances of a true coal occurring in a recent geological formation, although in the United States and in Hanover (on the very borders of the Netherlands), two or three such occurrences are on record. The coal here alluded to is an excellent quality of gas coal.

Curious Instance of Spontaneous Combustion of the Human Body.—Dr. Bertholle.—This paper relates a duly authenticated case of this rare phenomenon. The victim, a woman aged 37 years, was a confirmed drunkard. Many of our readers will recollect, perhaps, that Prof. Liebig wrote a paper on this subject some years ago, when the medico-legal question arose concerning the death of a noble lady in Germany.

Phosphide of Calcium Applied to Life-Buoys.—F. Silvas.—Experiments have been made at Toulon to try to attach to life-buoys another floating body provided with phosphide of calcium, which, on becoming wet, gives off spontaneously combustible phosphuretted hydrogen, thus emitting light to guide the man who might have fallen overboard and be in search of the life-buoy.

Revue Hebdomadaire de Chimie, February 17, 1870.

Modifications in the Mercurial Air-Pump.—Messrs. Alvergniat, Frères.—The improvement here alluded to cannot be well understood without reproduction of the cut; but there is no doubt that this modification will soon be generally adopted, since it greatly aids the efficiency of this apparatus.

Quality of the Kerosen Oil as Met with and Sold at New York.—C. J. Chandler.—The first portion of a report to the Imperial City's Board of Health on this subject.

Carbonisation of Dry (Non-Caking) Coal.—E. Péricot and T. Appolt.—This paper is a first instalment on the means by which coke of good quality may be made from *houille maigre*—that is to say

non-caking coal. This property may be due to either excess of carbon (as in anthracite), excess of oxygen (as, for instance, in the coal from Saarbrück, which contains 17 per cent of that element), or to excess of ash (as, for instance, the Boghead and some other Cannel coals); but, as regards the latter, there are other causes in play for preventing them from caking, and, among these, the water they contain in a peculiar manner.

February 24, 1870.

This number contains the continuation of the following original papers:—

Quality of the Kerosene Oil as Sold at New York.—Prof. C. J. Chandler.—The specific gravity of the native petroleums varies from 0·773 to 0·910; and the average composition of crude Pennsylvania petroleum is, in 100 parts—Gazoline (sp. gr., 0·744), 10 parts; naphtha (sp. gr., 0·752), 10 parts; oils fit for burning and lubrication, 76 parts, varying in sp. gr. from 0·844 to 0·760. The paper further contains a large amount of information concerning the American regulations for the sale and testing of petroleum, and gives a tabulated review of the composition of some specimens of kerosen sold at New York, from which it appears that some kinds contain no less than 90 per cent of the very volatile oils, while in other instances, again, the quantity of the latter is *nil*.

Carbonisation (Coke Manufacture) of Non-Caking Coal.—The main point here brought forward is the well-known washing process, whereby the earthy constituents of the coal are removed, and, having become decreased in quantity, admit of the agglomeration of the organic matter when heat is applied. The admixture of a good quality of caking coal is advocated for obtaining coke from anthracite.

Holtz's Electrical Machine.—[illegible].—This complete description of this machine, as improved by [illegible], is accompanied by a couple of woodcuts.

Annales de Chimie et de Physique, January, 1870.

This number contains only two original memoirs:—

Estimation of Carbon in Cast-Iron, Wrought-Iron, and Steel. M. Boussingault.—The paper, a lengthy essay on this subject, opens with the quotation of the results of an analysis of white cast-iron smelted with charcoal at Medellin, in New Grenada. In 100 parts, this substance contained:—Combined graphite, 4·40; silicium, 0·75; phosphorus, 0·07; sulphur, traces; nitrogen, 0·0118; manganese, 0·84; chromium, 1·95; vanadium, traces; iron, 92·50. The paper contains the following sections, headed—Attacking iron by the dry process—*i.e.*, with bichloride of mercury; attacking iron by the wet process; estimation of carbon in cast-iron, wrought-iron, and steel.

Temperature of Flames, and on Dissociation.—E. Vicaire.—This is the first instalment of a lengthy memoir on this subject, accompanied by several engravings.

February, 1870.

This number contains continuation and end of last-named memoir, and—

Migration of Nitrogen during the Process of Beet-Root Sugar Manufacture.—A. Renard.

Optical and Crystallographical Researches on the Clino-Rhombic Form of Tungsten.—M. des Cloizeaux.

Simultaneous Estimation of Carbon, Hydrogen, and Nitrogen in the Elementary Analysis of Organic Substances.—Th. Schlœsing.—This excellent memoir cannot be well understood without the reproduction of the several woodcuts annexed to it.

On the Effect Motion has upon the Vibrations of Sound, and on the Length of the Wave of the Rays of Light.—H. Fizeau.

Regulator for the Use of Gas in Chemical Laboratories.—Th. Schlœsing.—Cannot be usefully abstracted without the reproduction of the woodcuts.

Researches on Camphor and some of its Derivatives.—H. Baubigny.—This is the first portion of a lengthy monograph on this subject, divided into the following sections:—Introduction, treating briefly on the researches made on camphor by various authors; action of sodium upon camphor; action of water upon sodium products, and formation of borneol; action of the bromides and iodides of the radicals of the diatomic alcohols upon the sodium derivatives from camphor.

Moniteur Scientifique, No. 317, March 1, 1870.

Contains the following original papers:—

Oil Refining.—M. de Keyer.—This process is equally applicable to all fat, or fixed oils. Take, for 100 kilos. of oil, 600 grms. of liquid ammonia, diluted with the same quantity of water; the mixture is vigorously stirred for about half-an-hour, and next left quietly standing for three days, care being taken to keep the vessel containing the mixture well closed. The oil having been decanted from the sediment (which is applied for soap-making), is ready for use after washing with water and filtration.

Researches on Molasses, and on the Divers Processes of Sugar Refining as Applied in Paris.—Dr. Dubrunfaut.—A lengthy monograph, of interest chiefly to sugar refiners.

Direct Application of Suint to the Manufacture of Cyanides.—Léon Sauvage.—In reference to what was stated in this periodical (see abstract, vol. xxi., p. 71), this author writes to say that he obtained, on the 30th of December, 1864, a *brevet d'invention* for this invention, and that this *brevet* is now public property. The author's object is to state that his is the right of priority.

Journal für Praktische Chemie, No. 18, 1869.

This number contains the following original papers and memoirs:—

Preparation of Pure Titanic Acid and its Separation from Zirconium and Iron.—G. Streit and B. Franz.—The first section of this paper is devoted to a comparative review of the methods hitherto in use for the disintegration and solution of minerals containing the substances named above. The preparation of titanic acid by the method suggested by the authors, consists in fusing rutile, first, with three times its weight of carbonate of potassa at a high temperature in fire-clay crucibles. The fused mass is poured out on a piece of sheet-iron, so as to form, on cooling, a thin cake; this is next ground to powder, and exhausted with water, and, after removal of the silica, treated with crude hydrochloric acid, no heat being at first applied. The several operations of filtration and washing by decantation having been got through, the titanic acid is precipitated by means of a mixture of acetic acid and dilute sulphuric acid, and boiling, by the aid of steam, for some ten hours. The separation of zirconia from titanic acid is discussed at great length; the authors experimented with a solution containing 4·23 grms. of TiO_2, 0·188 of FeO, and 0·062 of Fe_2O_3, and added thereto the sulphuric acid solution of 0·613 grm. of zirconia. To the solution was then added its own bulk of acetic acid, and the liquid boiled; all the titanic acid was hereby precipitated, while iron and zirconia remained in solution. From the filtrate the two latter substances were precipitated by ammonia, and, after having been collected upon a filter, washed, dried, ignited, and weighed, the iron was estimated in the re-dissolved substance volumetrically.

Formation of Sulphuretted Hydrogen from Water and Sulphur.—J. Meyers.—While experimenting on the boiling-point of sulphur, the author detected the presence of sulphuretted hydrogen; and this induced him to make, purposely, an experiment whereby steam was made to pass over sulphur kept boiling in a tube. A large quantity of sulphuretted hydrogen was formed, and, simultaneously, pentathionic acid. The following formula explains the process:—

$$15S+10H_2O=10H_2S+5SO_3=H_2S_4O_6+5H_2S+5S+4H_2O.$$

This number contains the notice that Dr. H. Kolbe has been appointed chief editor of this journal, which will in future appear in fortnightly numbers, excepting that during the months of August and September no issue takes place; but, exceptionally, the journal will be published during these months in the current year, to make up for backward appearance during the first two months of 1870.

Revue des Cours Scientifiques de la France et de l'Etranger, February 26 1870.

This number does not contain any papers relating to chemistry or sciences allied therewith.

NOTES AND QUERIES.

Removing Silica.—Can any of your readers inform me of a practical mode of removing silica from large quantities of carbonate of potassium?—W. H.

Colours and Pigments.—(Reply to "A Reader, Church, near Accrington.")—There are not many works on the subject you refer to. One of the best is "Lehrbuch der Farben Fabrikation, &c., &c.," von T. G. Genteb (Brunswick: Vieweg and Son, 1860). As to the manufacture of blood and egg albumen, you mean, of course, the preparation of these articles in dry state, fit for preservation; and, for information thereupon, we refer you, among other works, to Schützenberger's 'Traité des Couleurs," and to Persoz's "Traité de l'Impression des Tissues.

Distilling Tar.—Consult "Coal, Petroleum, and other Distilled Oils," by Dr. Gesner (New York, London, and Paris: Baillière, 1861; later edition in 1865), and "Industrie der Mineralöle des Petroleums, Paraffins, und der Harze," von H. Perutz (Wien, 1868); also "Chemical Technology, or Chemistry in its Applications to the Arts, &c."

MEETINGS FOR THE WEEK.

MONDAY, 14th.—Geographical, 8.30.
—— Medical, 8. Anniversary.
—— London Institution, 4.
TUESDAY, 15th.—Royal Institution, 3. Dr. Rolleston, on "Nervous System."
—— Institution of Civil Engineers, 8.
WEDNESDAY, 16th.—Society of Arts, 8.
—— Meteorological, 7.
THURSDAY, 17th.—Royal Institution, 3. Prof. Odling, "Chemistry."
—— Royal, 8.30.
—— Chemical, 8. W. H. Perkin, "On Artificial Alizarine." Dr. Divers, "On Combinations of Carbonic Anhydride with Ammonia and Water."
—— Royal Society Club, 6.
FRIDAY, 18th.—Royal Institution, 8. Mr. J. F. Bateman, "Subway to France."
SATURDAY, 19th.—Royal Institution, 3. Mr. Lockyer, "The Sun."

THE CHEMICAL NEWS.

VOL. XXI. No. 538.

ON THE REACTION OF CHLORINE ON SULPHUR SALTS.*

THE following experiments, made some years ago in the laboratory of Owen's College, under the superintendence of Dr. Roscoe, may be of some interest as bearing on the action of chlorine and its congeners on the sulphur-acids.

In order to see how far the action of equivalent quantities of chlorine, bromine, and iodine on the same sulphurous-acid solution are comparable, solutions were prepared, one containing 5 grms. of iodine per litre, and the other such a quantity of sulphurous acid that a litre represented about 150 c.c. of the iodine solution. The exact relation between the two was determined before and after each set of experiments; and it was found that no appreciable alteration took place during the duration of any one set of experiments. A solution of washed chlorine in distilled water was also prepared, and kept in the dark, and, when required, diluted with distilled water to the required strength. The stronger solutions were weighed out in sealed glass bulbs, subsequently broken under the surface of the liquids to be acted on.

(*a*). Known quantities of chlorine solution were added to a measured column of sulphurous-acid solution, the latter being in slight excess. This excess was then titrated by the standard iodine solution.

(*b*). Cl solution was added to potassium-iodide solution, and the liberated iodine treated as the chlorine in (*a*).

(*c*). Carried out as (*b*), but potassium bromide used instead of iodide.

(*d*). Bromine liberated, as in (*d*), by Cl and KBr; KI then added, and the iodine thus liberated by bromine treated as that obtained in (*b*).

By subtracting from the iodine solution equivalent to the sulphurous acid used that required for the back titration, numbers were obtained representing the amount of iodine solution equivalent to sulphurous acid destroyed by chlorine, bromine, or iodine in these experiments. Each determination was done in duplicate, frequently in triplicate; and it is noticeable that, whilst the repetitions agreed remarkably closely in all cases where iodine acted on sulphurous acid, they usually showed some little divergence in the case of bromine, and considerably more in the case of chlorine.

Care was taken in all these comparative experiments to have the total volume of liquid in each case as nearly as possible proportionate to the quantity of chlorine originally employed, so that the circumstances of dilution in any set of experiments should be approximately uniform.

The following examples show the character of the numbers obtained, the same measured volume of chlorine solution, containing 0·88 grms. of Cl per litre, being used in each instance.

Iodine representing SO_2 destroyed by I (liberated by Cl and KI).	Iodine representing SO_2 destroyed by I (liberated by Cl and KBr, and by Br thus set free, and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
c.c.	c.c.	c.c.	c.c.
63·1	62·8	61·6	62·7
62·9	62·6	61·3	62·6
63·1	62·7	60·9	62·7
Mean 63·0	62·7	61·3	62·7

* Read before the Newcastle-on-Tyne Chemical Society, Feb. 24th, 1870, continued from last number.

Similarly, with other chlorine solutions, the following mean numbers were obtained from eighteen determinations:—

Grms. of chlorine per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
*7·00	49·8	44·5	51·3
0·30	57·0	56·5	56·9

The above numbers, calculated in each case to 100 parts of iodine, representing SO_2 destroyed by I (Cl and KI), are—

Grms. of Cl per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by I (from Cl and KBr, and from this B and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
7·00	100·0	—	89·2	103·0
0·88	100·0	99·5	97·1	99·5
0·30	100·0	—	99·2	99·9

It thus appears that the action of iodine is nearly the same, whether directly set free by Cl, or liberated by the circuitous process of evolving bromine from Cl and KBr, and then causing this bromine to act on KI, since the numbers obtained are no more different than might be anticipated from the combined effects of experimental errors, volatility of bromine, &c.; whilst the action of bromine in the two weaker solutions appears to be nearly the same as that of iodine; whereas, in the stronger solution, a larger quantity of SO_2 is destroyed by bromine than by iodine. Lastly, the action of chlorine appears, in the weakest solution, to be nearly identical with that of iodine, but, in the stonger solutions, differs considerably therefrom, and this difference, unlike that in the case of bromine, indicates a destruction of *less* SO_2 by chlorine than by an equivalent quantity of iodine.

From a similarly-conducted series of twenty-four determinations, the following mean numbers were also obtained as the relative actions of chlorine and iodine solutions:—

Grms. of Cl per litre of solution.	Iodine representing SO destroyed by I from Cl and KI.	Iodine representing SO_2 destroyed by Cl.
4·40	100·0	94·7
2·41	100·0	95·4
1·39	100·0	114·4
0·94	100·0	105·4

Experiments were also performed with gaseous chlorine. A known weight of potassium dichromate was treated with hydrochloric acid, in Bunsen's apparatus, and the liberated chlorine led directly into a known slight excess of sulphurous-acid solution, subsequently titrated back by the standard iodine. The iodine solution having been originally standardised from the amount of iodine set free by making the chlorine from a known quantity of dichromate act on potassium iodide, the relative actions of chlorine and iodine were directly calculable. In three experiments, the following numbers were obtained:—

Grms. of chlorine evolved per litre of sulphurous-acid solution employed.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by gaseous Cl.
0·36	100·0	109·8
0·33	100·0	113·0
0·33	100·0	112·8

It is clear, from the above-described experiments, that the difference in the action of chlorine and iodine does not depend solely on the strength of the solutions used. Probably temperature and photo-chemical action are also concerned.

Assuming that the action of iodine on sulphurous acid, under the circumstance experimented on, is always represented by the equation $H_2SO_3+H_2O+I_2=2HI+H_2SO_4$, it is evident that chlorine or bromine *might* cause the destruction of *more* SO_2 than corresponds to this equation,

* Nearly saturated Cl solution, containing, at 0°, 2·2 vols. of Cl gas to 1 vol. of water.

if their actions caused the formation of thionic acids. Thus, for tetrathionate, which, as the preceding experiments show, is only slowly acted on by iodine,

Tetrathionic acid.

$$7H_2SO_3 = H_2S_4O_6 + 3H_2O + 3H_2SO_4.$$

But how it happens that a *less* quantity of SO_2 is sometimes destroyed by chlorine than by the equivalent amount of iodine is more difficult to explain. Possibly, though this does not seem a very probable supposition, under the influence of light or of other unknown circumstances, free oxygen may be found which escapes without exerting its due influence on the sulphurous acid—

$$2H_2O + 2Cl_2 = 4HCl + O_2.$$

That free oxygen in aqueous solution acts comparatively slowly, at any rate in the dark, on sulphurous acid solution, is shown by the following numbers:—A quantity of saturated sulphurous acid solution was largely diluted with water, saturated with air, and kept in a well-closed opaque vessel. Samples, taken from time to time, indicated that the oxidising action of the dissolved oxygen lasted a considerable time, eighteen hours elapsing before the action became negligible; thus, a given volume (stoppered vessel containing about 300 c.c.) required—

Immediately after mixture..		42·3	c.c.	of iodine solution.
10 minutes	,, ,, ..	40·6	,,	,,
20 minutes	,, ,, ..	40·3	,,	,,
1 hour	,, ,, ..	40·0	,,	,,
2 hours	,, ,, ..	39·9	,,	,,
18 hours	,, ,, ..	39·3	,,	,,
40 hours	,, ,, ..	39·2	,,	,,

However, the following experiments indicate that, when the action of chlorine or sulphurous takes place without exposure to daylight, the quantity of acid destroyed is always in excess of that due to the equivalent amount of iodine. The previously-described experiments were performed in the diffused light of a laboratory; but the subsequent ones were all carried out in a cellar only lighted artificially—even the weighings of the chlorine solution being performed there, in order to avoid any possible photo-chemical action.

Weighed bulbs of chlorine solution were broken under known volumes of sulphurous acid, diluted the instant previously with warm or cold water, so as to obtain varying temperatures, and similar determinations were made by breaking chlorine water bulbs under potassium iodide solution at varying temperatures.

From twelve determinations, the following mean numbers were obtained:—

Iodine and Sulphurous acid.		Chlorine and Sulphurous acid.		
Temperature.	Iodine representing SO_2 destroyed by I.	Temperature.	Iodine representing SO_2 destroyed by Cl.	Rates.
14°	104 c.c.	16°	132 c.c.	100 to 127
40°	105 ,,	35°	186 ,,	100 to 177

It thus appears that, while variation of temperature makes but little alteration in the action of iodine, it has a great influence on that of chlorine, the difference being the higher the temperature, and always indicates the destruction of more SO_2 by chlorine than by iodine.

To find if the action of chlorine and iodine becomes identical at 0° with any strength of chlorine solution, bulbs containing chlorine water of varying strengths were broken.

(*a*). Under known volumes of sulphurous acid solution at the temperature of the cellar (viz., 12° C. throughout this set of determinations).

(*b*). Under sulphurous acid cooled to 0° by additions of fragments of pure ice (found to have no effect when melted on the iodine solution).

(*c*). Under potassium iodide at 12° and at 0°: the obtained at these two temperatures never differed by more than 0·1 c.c. from one another (out of 40—50 c.c. used).

The following mean numbers were got from thirty-three determinations:—

Grms. of Chlorine per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by Cl at 12° C.	Iodine representing SO_2 destroyed by Cl at 0° C.
*7·20	100·0	106·1	103·4
0·68	100·0	102·5	103·9
0·78	100·0	103·3	102·6

It thus appears that at 0° there is little difference between the action of a saturated solution of Cl and one containing only about one-ninth of that amount.

These experiments would tend to show that, when the action of chlorine or sulphurous acid takes place, not under the influence of light, a larger quantity of acid is destroyed than corresponds to the equation—

$$H_2SO_3 + Cl_2 + H_2O = 2HCl + H_2SO_4,$$

this extra amount varying with the temperature, and, possibly, with the strength of the solution; whilst, if the action takes place in daylight, the result is so modified, that sometimes more, and sometimes less acid is destroyed than that indicated by this equation. In the case of bromine, also, apparently, there is some irregularity in the action under different circumstances, as is shown by the non-uniform results obtained on repetition of determinations. Iodine, on the other hand, as Bunsen has shown (*Ann. der Chem. und Pharm.*, vol. lxxxvi., p. 265), acts with great regularity and uniformity in accordance with this equation under considerably varied circumstances, unless a solution containing more than 0·4 grms. of SO_2 per litre be used.

ON SOME NEW SULPHO-COMPOUNDS.

By S. E. PHILLIPS.

IF botanists were to exercise little or no discrimination between natural and aberrant or monstrous forms, we should make but little progress in the very interesting but difficult problem of botanical arrangement and classification. But chemists are perpetually giving us the most puzzling problems; and their accumulation has landed us in a jargon of types and nomenclature utterly bewildering.

It is in this way M. Schneider has just treated us to some new sulpho-saltic types. Hence the following list (see CHEMICAL NEWS, vol. xx., p. 264):—

1.	Sulphide of silver and iron	$Ag_2Fe_2S_4$
2.	,, ,, iron and sodium	$Na_2Fe_2S_4$
3.	,, ,, bismuth and sodium	$Na_2Bi_2S_4$
4.	,, ,, copper and potassium ..	$K_2Cu_8S_6$
5.	,, ,, copper and sodium	$Na_4Cu_6S_6$
6.	,, ,, copper, iron, and potassium	$K_2FeCu_3S_4$
7.	,, ,, copper, iron, and sodium ..	$Na_2FeCu_3S_4$

We thank him very much for not giving us the rational types of this curious assemblage; whether they are modified types of water or hydrochloric acid, or represent of these arch-types, single, double, or multiple atoms; these are curious points that do not disturb an old chemist. Hence we proceed at once to see how far the old views and intelligible principles may cover the new ground.

The first two would seem to be the most normal form of sulpho-salts for such feeble acid-radicals as copper and iron. The type is a most familiar one, and has a wide range in mineral chemistry. It is that of the corresponding oxy-ferrates and oxy-aluminates—

$$MO + Al_2O_3$$
$$MO + Fe_2O_3$$
$$MS + Fe_2S_3$$
&c.

* Nearly saturated chlorine water.

No. 3 is a simpler form—$NaO+BiO_3$ or $NaS+BiS_3$.

The others are more complex, or, at any rate, more unusual, if not hybrid and abnormal.

No. 4 is an utter puzzle, and there is probably some mistake in the figures; or is it possible that any of the varied forms of modern type could resolve such an assemblage of elements?

Nos. 5, 6, and 7 may prove varied or hybrid forms of the common sesqui-type above. This hybridity (or by whatever name it should be called) assumes three forms.

First, in No. 5, one S is replaced by one Cu, a most unusual, but perhaps not an impossible, anomaly. As such, it would be $NaS+CuS_2Cu$. This may appear to some a large measure of faith in the preservation of a generic type; but, on the other hand, it must be observed that this type is well and widely established, and it is only mooted *pro tem*, until some modern view can supersede it in consistency and simplicity.

Nos. 6 and 7 may be varieties which have two characteristics. The first is a common one, in illustration of which thousands of cases might be cited where Fe replaces Cu, to the preservation of the same type and general properties.

The second one is forced alike upon the attention of old and new chemists, and perhaps has not received that careful attention it so well deserves, though, in some respects, it has been seized hold of and treated as if it were a special part of modern chemical philosophy. I allude to the hypothesis that the ordinary sesqui-sulphide of copper, in these two cases, is a sulphide where two ordinary atoms have a double condensation, and act and re-act as one element. The type of these two bodies would be thus—

$$\left.\begin{matrix} KS+\underline{Cu_2}S_3 \\ NaS+\underline{Cu_2}S_3 \end{matrix}\right\} \underline{Cu_2}=(Cu_3Fe)$$

As modern chemists have perhaps unwisely abandoned the method of indicating the doubled atoms by a cross-line (thereby occasioning great trouble and perplexity to some who either do not or will not understand the new arrangements), I have here adopted it with a new signification. It bespeaks a molecule of double condensation, but which is not a duad in the modern acceptation—viz., it does not represent the equivalence of 2H, &c. The underlining is a convenient way of referring any common type to a marginal explanation.

The entire philosophy of allotropic or isomeric variation will not be fully embraced by any one feature, but this one has powerfully struck the writer in the course of study for many years past. It seems to take place with both elements and compounds; and one of the earliest instances probably on record, is that of $(CO)=14$ (the radical of carbonic acid) and $(\overline{CO})=28$ (the radical of oxalic acid), both of which represent 1 atom of H or other equivalent in a variety of substitutional type modifications. We have HH_2,N (ammonia); and, by a generic reaction, carbonic acid gives $(CO)H_2,N$ (carbamide); and, similarly, oxalic acid gives $(\overline{CO})H_2,N$ (oxamide), &c., all normal 2-vol. compounds. And these, by a further extension of the same reaction, give carbamic and oxamic acids, &c.

The ammonia and atmonia type affords a striking illustration: it is as if ammonia, $(H_3N)=17$, by an allotropic or double condensation, gave atmonia, $(\overline{H_3N})=34$; both interchangeably representing one constituent and one vol. in a wide series of combinations.

The precise case here given is, as yet, hypothetical; but the facts are wide and well-known in great extensions.

Ammonia,	HH_2,N	Oxide of ammonium,	HH_2N,O
Ethylia,	EH_2,N	„ ethylium,	EH_2N,O
UREA,	$(CO)_2H_4,N_2$ ..	„ urea,	$(CO)_2H_2N_2,O$
		&c.	

Whatever the future may unfold in regard to this isomeric condensation, one thing at least is certain—that copper was one of the first elements to force it upon the attention of chemists.

As we have MnO_3 and Mn_2O_7,
So we have NH_3 and N_2H_7;

Such being an old and familiar transitional arrangement *within prescribed limits* of mineral chemistry, the first being a ratio of one to three, the second that of one to three-and-a-half.

If old mineral chemistry has lighted up the path into the profounder depths of organic chemistry, truly may we say she is likely to be repaid with a mighty interest of reflex light and illumination.

It only remains to compare the percentage composition of the old and new types—

	NEW.			OLD.			
1. Sulphide of silver and iron	Ag_2 .. 47·38	.. ..	47·38 ..	Ag	$=AgS+Fe_2S_3$		
	Fe_2 .. 24·56	.. ..	24·56 ..	Fe_2			
	S_4 .. 28·06	.. ..	28·07 ..	S_4			
2. „ iron and sodium	Na_2 .. 12·43	.. ..	12·80 ..	Na	$=NaS+Fe_2S_3.HO$		
	Fe_2 .. 31·07	.. ..	31·28 ..	Fe_2			
	S_4 .. 35·44	.. ..	35·75 ..	S_4			
	HO .. 19·58	.. ..	20·17 ..	HO			
3. „ bismuth and sodium	N_2 .. 7·79	.. ..	7·79 ..	Na	$=NaS+BiS_3$		
	Bi_2 .. 70·51	.. ..	70·51 ..	Bi			
	S_4 .. 21·70	.. ..	21·70 ..	S_4			
4. „ copper and potassium ..	K_2 .. 10·05	.. ..	(?) ..	(?)	(?)		
	Cu_8 .. 65·27						
	S_6 .. 24·68						
5. „ copper and sodium	Na_4 .. 13·84	.. ..	13·86 ..	Na	$=NaS+Cu_2S_2Cu$		
	Cu_6 .. 57·29	.. ..	57·11 ..	Cu_3			
	S_6 .. 28·87	.. ..	29·03 ..	S_3			
6. „ copper, iron, and potassium	K_2 .. 17·28	.. ..	10·994 ..	K	$=KS+\underline{Cu_2}S_3$	$\underline{Cu_2}=Cu_2Fe$	
	Fe .. 12·38	.. ..	13·348 ..	Fe			
	Cu_3 .. 40·08	.. ..	45·108 ..	Cu_3			
	S_4 .. 28·27	.. ..	30·550 ..	S_3			
7. „ copper, iron, and sodium ..	Na_2 .. 10·94	.. ..	13·457 ..	Na	$=NaS+\underline{Cu_2}S_3$		
	Fe .. 13·32	.. ..	12·993 ..	Fe			
	Cu_3 .. 43·50	.. ..	43·871 ..	Cu_3			
	S_4 .. 30·44	.. ..	29·698 ..	S_3			

As to the nomenclature, nothing could be plainer: they are sulpho-ferrates, sulpho-cuprates, or sulpho-bismuthates of sodium, &c., corresponding with the oxy-ferrates, cuprates, or bismuthates, where we have agreed, in deference to common usage, that the oxy-prefix shall be understood, though unexpressed.

And, just as a sulphate or ferrate means oxy-ferrate of *an oxide*, so sulpho-ferrate or chloro-ferrate means sulpho-ferrate of *a sulphide* or chloro-ferrate of *a chloride*, the latter prefix being implied in the former.

ON A

NEW METHOD OF SEPARATING TIN FROM ARSENIC, ANTIMONY, AND MOLYBDENUM.

By FRANK WIGGLESWORTH CLARKE, S.B.

Some time since, happening to notice that the remarkable highly-crystalline precipitate formed by oxalic acid in a solution of stannous chloride was not blackened or otherwise affected by sulphuretted hydrogen, I was led to a series of experiments concerning the action of the above-named acid upon certain metallic sulphides, and obtained the following results.

Both sulphides of tin, if moist and freshly precipitated, are readily decomposed by moderately-long boiling with an excess of oxalic acid, H_2S being given off. The monosulphide is converted into the insoluble, crystalline stannous oxalate; while the yellow disulphide is completely dissolved. The commercial "Mosaic gold," however, seems to be unacted upon by the reagent. In presence of an excess of oxalic acid, tin cannot be precipitated by H_2S.

The sulphides of arsenic, even upon very long boiling with the acid, are almost unattacked. Very minute traces of the metal sometimes go into solution, but may be re-precipitated by a bubble or two of H_2S. Accordingly, the presence even of an enormous excess of oxalic acid does not hinder the precipitation of arsenic as sulphide.

The sulphide of antimony behaves in a somewhat different manner. Although, upon long boiling with oxalic acid, considerable quantities of the metal are taken into solution, yet every trace of it may be re-precipitated by H_2S.

Molybdic trisulphide appears to be wholly unattacked by oxalic acid, even upon very long boiling.

With the sulphides of tungsten I have obtained discordant results. Under certain circumstances, they seem to be wholly insoluble in the acid; while, at other times, they are decomposed completely, and partly taken into solution.

By availing myself of the solubility of the sulphides of tin in oxalic acid, I have been enabled to separate tin perfectly from arsenic and molybdenum, and almost perfectly from antimony. When only arsenic and antimony are to be separated from tin, I find it best to proceed as follows:—To the solution containing the three metals (this solution being prepared in the usual manner for the precipitation of the sulphides) I add oxalic acid, in the proportion of about 20 grms. of the reagent for every gramme of tin, taking care to have the whole so concentrated that the acid will crystallise out in the cold. I then heat to boiling, and pass in sulphuretted hydrogen for about twenty minutes. No precipitate appears at first; but, as soon as the liquid is saturated with the gas, the sulphides of arsenic and antimony begin to fall, and, in a very few moments, are completely thrown down. Then, as usual, the whole should be allowed to stand about half-an-hour in a warm place, before filtering. Every trace of arsenic and antimony is precipitated, so that, in the filtrate from the sulphides, neither of these metals can be discovered by Marsh's test, nor can any antimony-stain be produced with zinc upon platinum. I have carefully experimented to learn whether oxalic acid could interfere with either of these tests, and find that it has not the slightest influence upon them. The sulphide of arsenic is absolutely free from tin; but the antimony always carries down a minute trace of that metal with it: this trace, however, if the operation has been carefully performed, can scarcely be detected, and generally may be ignored with safety. If, however, the greatest accuracy is desired, it may be well to re-dissolve the sulphide of antimony in an alkaline sulphide, decompose the solution with an excess of oxalic acid, boil with a little strong sulphydric-acid water, filter, and add the filtrate to the tin solution previously obtained.

To separate tin from molybdenum, owing to the difficulty of precipitating the latter metal with H_2S, I have been obliged to slightly vary my process. I find that, by adding an alkaline sulphide in excess to a solution containing molybdate, then decomposing the sulphur-salt formed with a considerable quantity of dilute chlorhydric acid, and allowing the whole to stand over night in a warm place, every trace of molybdenum is precipitated. The sulphide thus obtained can be easily washed with a mixture of dilute chlorhydric acid and ammonic chloride. If, now, by this process we throw down tin and molybdenum together, every trace of the former metal may be dissolved out by boiling the mixed sulphides for about three-quarters-of-an-hour with oxalic acid, in the proportions which I have already given. It is best to have present in the solution, while boiling, a little dilute chlorhydric acid.

If antimony, also, is contained in the mixture, it is necessary, just before ceasing to boil, to add to the solution an equal volume of strong sulphydric-acid water, to re-precipitate any of that metal which may have gone into solution. Upon filtering, no molybdenum can be detected in the filtrate by any ordinary tests, and the molybdic sulphide is absolutely free from tin. In all these cases, it is assumed that the tin is in the form of a stannic compound. It must be borne in mind that the lower sulphide of this metal is converted by the acid into an oxalate insoluble in water; but, as the latter dissolves to an almost unlimited extent in dilute HCl, its formation need not interfere with an analysis.

Since the presence of oxalic acid interferes somewhat with the complete precipitation of tin by ordinary methods, I was subjected to some trouble in finding a process for determining that metal after the separation. At last I found it could be thrown down as follows:—The solution, after being rendered slightly alkaline with ammonia, is mixed with enough ammonic sulphide to re-dissolve the precipitate at first formed; an excess of *acetic* acid is added, and the whole allowed to rest several hours in a warm place. *Acetic* acid must be used, for stronger acids would be liable to set free some of the oxalic to re-dissolve the tin. The precipitate, which at first varies from white to pale yellow, rapidly darkens in colour, and seemingly consists of a mixture of oxide and sulphide of tin. It should be washed with a solution of ammonic nitrate, and, after ignition, is weighed as SnO_2. In two successive experiments, in which I mixed a weighed quantity of tin with unknown proportions of arsenic and antimony, I received of the tin, after making my separation, respectively 99·93 and 99·57 per cent. The loss in the second case was due to my not having allowed the tin-precipitate to settle sufficiently long before filtering—in other words, to incomplete precipitation.

The arsenic and antimony, being in the form of sulphides, may be estimated by any of the ordinary methods. They may be best separated by Bunsen's process with sulphurous acid, which, though far from perfect, is superior to all others. Lensen's method, in which the arsenic is precipitated from the sulphur solution of the two metals as ammonia-magnesian arsenate, is worthless.

A couple of years ago, I made a few experiments upon indirectly determining the proportions of tin and antimony in alloys of the two metals. I oxidised a weighed

quantity of the alloy with nitric acid in a porcelain crucible, heated the resulting oxides with ammonic nitrate, and then (regarding the tin as converted into SnO_2, and the antimony into Sb_2O_4) calculated the proportions of the metals from the increase in weight. This method, although by no means giving me accurate results, served very well for rough approximate determinations. I cite it here simply as an easy and convenient process for obtaining a close idea of the constitution of any alloy composed of the two metals. Possibly the method might be so modified as to give accurate determinations.—*American Journal of Science*, Jan., 1870.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 114).

Lesson III.

Specimens Required—Flour, Starch (Arrow-root, Potato-starch, or Brown and Polson's Corn Flour), Chalk (in Lump, not Whiting or Washed Chalk), Powdered Lump-Sugar, and Common Table-Salt.*

Examine by placing a minute quantity of each of these white powders on the stage-plate, and examine with O1, by reflected light, as in preceding lessons. Notice the different appearances of each. The flour will be found to contain numerous rounded, glittering bodies (starch granules), mixed up with a quantity of matter not easily defined with the power employed. The starch consists entirely of these shining substances, which, in the larger kinds, as "Tous-les mois," cause a distinct glittering appearance without any optical aid, if examined in a good light. The chalk is apparently structureless. The sugar and salt exhibit numerous crystals, more or less broken.

The student will do well to examine the solubility of these substances, by shaking a little of each in a test-tube, with water. Small portions should also be heated to redness, on a slip of platinum foil, in the flame of a spirit-lamp. The flour and starch will be carbonised and burnt to an ash, if the heat is long continued. The chalk will still remain white. The sugar will melt, and then carbonise. The salt will decrepitate or crackle, and bound off the platinum.

These simple chemical examinations should not be neglected by the microscopist, especially when examining unknown substances. Some skill in the use of the blowpipe may occasionally be of service. Solubility of a substance in water or other fluids may be tested under the microscope, and with the advantage that very small quantities are sufficient for experiment. Other reagents may also be employed. "Beale," p. 201.

Flour and Starch.—Place a little of the starch and flour on separate slides, with a drop of water; stir up with the point of a knife or needle, to diffuse the particles; cover with thin glass, and view with same power, first with dark-field illumination, and afterwards by transmitted light. Then use O¼M by transmitted light. The flour will be seen to consist of the before-mentioned rounded bodies, with a small admixture of fragments of membrane, cell, wall, &c. These are best seen in meal made by crushing or grating a grain of corn, as flour in general is too finely sifted to contain much of these textures. The slide of starch will exhibit the same rounded bodies, starch granules. They are best studied in a large-grained kind, such as *Tous-les-mois*,† the product of *Canna edulis*. With O¼M and transmitted light, a number of concentric rings will be seen, surrounding a spot known as the *hilum*. Microscopists differ respecting the nature of these markings (see article, *Starch*, "Micrographic Dictionary," p. 657; "Carpenter," p. 399). Examine with *polariscope* O1, and, if possible, with higher powers. Notice the characteristic black cross, having its centre at the hilum. In oat-starch the black cross is wanting, the grains are polygonal, and clustered in rounded masses. Test the contents of the slides with a solution of iodine in water, made by placing a small crystal in distilled water. When it has acquired a straw colour, it will be of sufficient strength; only a minute quantity will be dissolved. A small drop of this reagent is to be placed at the edge of the cover with a pointed pipette, or, better, with one of the test-bottles with perforated conical stoppers. When the iodine reaches the starch granules, they will be stained of a violet colour. This and the polarisation test will readily distinguish starch granules from other round bodies. A series of starches from various plants should be mounted, and kept for comparison. Two slides of each should be prepared, one dry, the other in balsam, for examination with the polariscope. When starch is mounted in balsam, care should be taken to employ as little heat as possible. Starch granules are not well preserved in fluids. Starch may be separated from flour by making it into a stiff paste, tying it in a muslin bag, and kneading in water. The gluten will be left in the bag, and the starch will fall to the bottom of the vessel, and can be cleaned by washing and decantation of the supernatant fluid. Roots, &c. (as potatoes and carrots), can be crushed or grated, and the starch washed out, cleaned, and collected. Starch may be viewed *in situ* by cutting thin sections of potato. These may be dried by the ether process (vol. xix., p. 194), and some mounted dry, and others transferred to benzol, and then mounted in balsam.

Starches from various sources, and the structure of wheat, barley, and other kinds of grain, are accurately figured in "Hassall," pp. 242—256 and 314—321.

The student should make accurate outline-sketches of all the starches examined, with the camera-lucida or tinted reflector, selecting, in each specimen, the largest and smallest granules, and also some of intermediate size. A scale should be drawn on the paper from the micrometer. The shape and dimensions of starch granules and other similar objects are readily compared from such drawings, and with far greater facility than from lists of micrometric figures.

Chalk.—Scrape a small portion of the chalk upon a slide. Place upon it a drop of water, stir it up, allow the larger particles to subside, and then gently tilt the slide, so that the water may run down, and carry with it the lighter particles. Absorb the surplus wet with blotting-paper, dry cautiously over the lamp-chimney, and mount in balsam.

* This is a very cleanly prepared *maize*-starch, which may be used for nearly every purpose where arrow-root is required. It would be well if manufacturers would call things by their right names. The term "flour" is likely to mislead; it means something quite different. Corn-starch or maize-starch would be more suitable.

† *Tous-les-mois* can be obtained of Messrs. Fortnum and Mason; also *genuine* arrow-root and other materials, which can be depended upon for use as standard samples.

Examine with O¼, or [O1, E2 or 3] black-field illumination, with -Parabola or [*spotted-lens*]. If the preparation has been successful, *Foraminiferæ* may be distinguished among some of the particles. It is well to make two or three preparations, in case of failure.

To obtain the shells, sponge-spicules, &c., separately, it will be necessary to break up the chalk. This is best effected by boiling in a solution of sulphate of soda, made strong enough to crystallise on cooling: on this taking place, the chalk will be found to be disintegrated (Quekett's "Lectures on Histology," vol. ii., p. 80). Sufficient water should then be added to dissolve the crystals, the mixture agitated, and the chalk allowed to settle. The fluid should be decanted, the vessel again filled up with water, and decantation repeated before the finer particles have subsided. By continuing this process, if carefully managed, the shells will be obtained, eventually, nearly or quite clean. The washings should be allowed to settle, and be examined with the microscope, to ascertain whether they contain any of the smaller fossils. The shells may be mounted dry or in balsam. The result will vary according to the locality from which the chalk was obtained.

Another very efficient process, by Mr. E. H. Robertson, will be found in *Science Gossip*, vol. iii., p. 36.

If the sponge-spicules and siliceous fossils only are required, they can be obtained by dissolving the chalk in dilute hydrochloric acid.

The coarse matter left after chalk has been washed for the purpose of making whiting is, when it can be procured, a good material to operate upon, as it is much richer in minute fossils, which are left in the heavier portions of the chalk.

The *Polycystinæ* may be obtained from the "Barbadoes-earth," by a process fully described by S. Furlong, *Quarterly Microscopical Journal*, Jan., 1861; also quoted by Davies, in "Mounting Microscopic Objects," p. 64.

Sugar and Salt.—The preliminary examination has already shown that these two substances differ materially in appearance from the others with which they were compared. While they exhibited none of the organised structure of the flour and starch, yet the difference between them and the chalk was very marked. They presented, when not too much crushed, traces of a certain regularity of form, which was entirely absent in the latter mineral. The condition of both the sugar and salt was very unfavourable for the study of these regular forms, which are known as crystalline. For further examination, it will be necessary to procure uninjured specimens.

Well-formed crystals may generally be found in most samples of good moist-sugar: a few of these are to be mounted in balsam, for examination. Sugar is rather difficult to crystallise in the small way, the general result being an amorphous film on the slide. For a very full account of sugar, see "Hassall," pp. 181—198.

Crystals of salt are easily obtained. Make a strong solution in distilled water, by boiling in a test-tube, and filter while hot. A drop of this fluid, placed upon a slide, will soon deposit a number of cubic crystals. These and the sugar-crystals may be viewed with a low power, O2, and dark-field illumination, by means of the Parabolic Reflector or [*spotted lens*]. This mode of lighting is very useful in such examinations, as it aids considerably in estimating solidity. Beyond regular mathematical form, no structure is to be observed in these bodies. *Polarised light*, however, renders certain optical peculiarities apparent.

Arrange the microscope for the use of the polariscope: it will then be seen that the crystals of salt are not at all affected by the altered illumination, and this is the case with all crystals belonging to the cubic system: crystals of potash-alum will supply another example. Let the sugar now be examined in the same way: it will be found, upon rotating the analyser or polariser, that they either become coloured or, when the field is darkened, remain luminous. If the thickness of the crystals is not adapted to produce colour, the use of a suitable selenite film will assist in obtaining it. It is here evident that polarised light reveals something which we should not be aware of without its aid: it supplies the means of determining whether a crystal possesses the property of double refraction or not.

The forms and colours of many crystals are extremely beautiful, and a collection is very easily made. As a long list will be found in "Carpenter," p. 773, only a few salts will be mentioned here.

Make a hot saturated solution of sulphate of copper. If a drop of this warm solution is placed upon a slip of glass, and examined at once,* long crystals, with sloping ends like a turner's chisel, will be seen shooting out from the edge, which will eventually cover the centre. If a small quantity of nitrous ether be added to the solution, a number of the crystals will be obtained in the form of separate rhomboids, which will shine like richly-coloured gems on the black field of the polarising microscope. Both slides, when dry, should be mounted in balsam, and labelled.

Some curious phenomena attending the crystallisation of sulphate of copper are described by Mr. R. Thomas in the *Quarterly Microscopical Journal* (1866, p. 177). An abstract of the paper, with figures, will be found in "Beale," p. 214.

The crystals of salicine are very easily made, and are very good examples of radiating crystals. A saturated solution in distilled water is to be made, and a drop, placed on a carefully-cleaned slide, is to be evaporated over the lamp until it dries into an amorphous mass. Upon cooling, a number of circular groups of crystals will generally be formed; this may be aided by breathing on the slide, the moisture often inducing the formation of the crystals. When sufficiently developed, the process should be stopped, by gently heating over the lamp-chimney, and mounting at once in balsam.

An account of the mode of making the beautiful flower-like crystals of sulphate of copper and magnesia is given in "Mounting Microscopic Objects," by T. Davies, p. 76.

(To be continued.)

Manufacture of White-Lead.—An invention is at present being tested by which ordinary galena, after having been crushed in an ore crusher, is roasted in a desulphurising kiln, and next mixed with carbon (preferably in the state of fine-washed pea or dust anthracite coal) in the proportion of half and half. This mixture is heated in a peculiarly-constructed furnace; and the dense white vapours which are given off are conveyed into a separate chamber, and strained, by passing through bags or screens of muslin, or are allowed to deposit slowly, and, after cooling, collected, as in the case of the manufacture of zinc-white.

* For this purpose, the microscope must be placed vertically, to prevent the fluid running off the slide, as the observation is best made without a cover. The instrument should only be used in this position when absolutely necessary, as it is uncomfortable and inconvenient.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

(Concluded from p. 117.)

Ordinary Meeting, February 22, 1870.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President in the Chair.

"*On the Organic Matter of Human Breath in Health and Disease*," by Dr. ARTHUR RANSOME, M.A.

The vapour of the breath was condensed in a large glass flask surrrounded by ice and salt, by which a temperature several degrees below zero was obtained. The fluid collected was then analysed for free ammonia, urea and kindred substances; and for organic ammonia—the method employed being that invented by Messrs. Wanklyn and Chapman for water analysis.

The breath of eleven healthy persons and of 17 affected by different disorders was thus examined, and the results were given in two tables.

The persons examined were of different sexes and ages, and the time of the day at which the breath was condensed varied.

In both health and disease the free ammonia varied considerably, and the variation could not be connected with the time of the day, the fasting or full condition. Urea was sought for in fifteen instances—three healthy persons and twelve cases of disease—but it was only found in two cases of kidney disease, in one case of diphtheria, and a faint indication of its presence occurred in a female suffering from catarrh.

The quantity of ammonia, arising from the destruction of organic matter, also varied, possibly from the oxidation of albuminous particles by the process of respiration; but in healthy persons there was a remarkable uniformity in the total quantity of ammonia obtained by the process. Amongst adults the maximum quantity per 100 minims of fluid was 0·45 of a milligramme, and the minimum was 0·35.

A rough calculation was given of the total quantity of organic matter passing from the lungs in twenty-four hours—in adults about 3 grs. in 10 ozs. of aqueous vapour, a quantity small in itself, but sufficient to make this fluid highly decomposable, and ready to foster the growth of the germs of disease.

In disease there was much greater variation in the amount and kind of organic matter given off.

In three cases of catarrh, one of measles, and one of diphtheria, the total ammonia obtained was much less than in health—less than 0·2 of a milligramme—a result probably due to the abundance of mucus in those complaints, by which the fine solid particles of the breath were entangled.

In two cases of whooping cough it was also deficient, but as they were both children, the lack of organic matter may have been due to their age.

In cases of consumption, also, the total ammonia was less than in health; but in one case of this disease associated with Bright's disease a large amount of organic matter was given off, a portion of it due to urea.

In kidney diseases the largest amount of organic matter of all kinds was found in the breath. The ammonia in one case of Bright's disease was 1·8 milligrammes in 100 minims of fluid, and urea was largely present. Perhaps this fact might be taken as an indication of the need of measures directed to increase the activity of other excretory organs.

In one case of ozona or offensive breath the total quantity of ammonia obtained was greater than in any healthy subject, but the excess was chiefly due to organic matter.

One convalescent case of fever was examined, and the total ammonia was found to be deficient.

The air of a crowded railway carriage, after fifteen minutes occupation, was also tested by this method and in about 2 cubic feet 0·3 milligrammes of ammonia and 3 milligrammes of organic matter were found.

With reference to the presence of organic matter in the atmosphere, it was pointed out that the subject was in no way a novel one, and that it had, during the last thirty years, been very fully investigated by many observers, more especially by Schwann, Dusch, Schroeder, Helmholtz, Van den Broeck, Pasteur and Pouchet, but it was shown that it is to Dr. Angus Smith that we owe the discovery of the readiness with which living organisms are formed in the condensed breath of crowded meetings, and the determination of the actual quantity of organic matter in the air of different localities.

Mr. Dancer's calculation of the number of spores contained in the air was noticed, but a source of error was pointed out in the readiness with which organisms are developed in suitable fluids, even in the course of a few hours. Observations upon the organic particles of respired air had at different times been made by the author.

1. In 1857, glass plates covered with glycerine had been exposed in different places and examined microscopically. Amongst others, in the dome of the Borough Gaol, to which all the respired air in the building is conducted, organised particles from the lungs and various fibres were found in this air.

2. During a crowded meeting at the Free Trade Hall air from one of the boxes was drawn for two hours through distilled water, and the sediment examined after thirty-six hours. The following objects were comprised:—Fibres, separate cellules, nucleated cells surrounded by granular matter, numerous epithetial scales from the lungs and skin.

3. The dust from the top of one of the pillars was also examined, and in addition to other objects, the same epithetial scales were detected.

4. Several of the specimens of fluid from the lungs were also searched with the microscope. In all of them epithetium in different stages of deterioration was abundantly present, but very few spores were found in any fresh specimen. On the other hand, after the fluid had been kept for a few hours, myriads of vibriones and many spores were found.

In a case of diphtheria, confervoid filaments were noticed, and in two other cases, one of measles and one of whooping cough, abundant specimens of a small-celled torula were found, and these were seen to increase in numbers for two days, after which they ceased to develope.

These differences in the nature of the bodies met with probably show some difference in the nature of the fluid given off; but it was pointed out that they afford no proof as yet of the germ theory of disease. They simply show the readiness with which aqueous vapour of the breath supports fermentation, and the dangers of bad ventilation, especially in hospitals.

Dr. E. LUND and Dr. H. BROWNE stated that they had also made experiments, the results of which were, in general, confirmatory of those obtained by Dr. Ransome.

QUEKETT MICROSCOPICAL CLUB.

THE annual *conversazione* of this club took place at University College on Friday evening, and was attended by a very numerous assembly of members and visitors.

The objects exhibited under the microscopes comprised specimens from nearly every branch of microscopical science, and evinced by their novelty an evident desire on the part of the members to cultivate every source likely to yield instruction. Amidst so much to attract attention it is impossible to make a selection; we may, therefore, merely remark that amateurs and professionals were equally assiduous in contributing to the general entertainment of the company. In addition to the objects exhibited, an interesting collection of photographs lent by the India

Office, the Autotype Company, Mr. Frank, Mr. Good, and Mr. A. L. Henderson were much admired.

The whole process of micro-photography was demonstrated at frequent intervals by the Messrs. Solomon, the actinic influence being derived from their new magnesium lamp. Mr. Apps exhibited some large Gassiot's cascades and Geissler's tubes illuminated by his celebrated induction coil, and Mr. James How displayed Dr. Maddox's microphotographs and some views of Swiss scenery, &c., by the aid of the oxy-hydrogen light. The meeting may be described as eminently successful.

NOTICES OF BOOKS.

First Lessons in Inorganic Chemistry. By T. WARD, F.C.S., &c. Manchester: John Heywood. London: Simpkin, Marshall, and Co. 286 pages.

THERE is already more than a superabundance of small text-books and manuals on chemistry; and it is a matter for wonder that, while there is no lack of really excellent books for young pupils, so many authors rush into print, imagining that they can improve upon what exists, and evidently forgetting "*Comment fait on des livres? Avec des livres.*" Let us briefly glance at the contents of this little volume. It partakes, in its arrangement, of two excellent works—viz., Stöckhardt's well-known book, and the small volume written by Professor Roscoe. We are sorry to be compelled to say that Mr. Ward's book is inferior to each of these, individually, as it is deficient in that lucid and precise clearness of exposition and soundness of definition which so eminently characterises the two works just alluded to. While we thus express our opinion, we must in all fairness also say that, as far as we have perused Mr. Ward's book, we have not found therein any heterodox or incorrect statements. The book is well got up, is provided with woodcuts, and contains some very useful tables relating to weights and measures, thermometer degrees, and a copious index. There is also added a chapter on qualitative analysis, which is, however, too brief to be of much use.

An Introduction to the Study of Chymistry, written for the People. By CUTHBERT C. GRUNDY. London: Simpkin, Marshall, and Co. 1870. 108 pages.

OUR first remark applies to the use and spelling of the word *chymistry*. Although the origin, or primitive meaning of this word is not satisfactorily explained, there is little doubt about the proper spelling, omitting even for the moment so old an origin as that which is sometimes assigned to chemistry as the Egyptian art, or as the secret art of transmutation, as practised by the Chémi (the Koptic for Egyptians). It is undeniable that Zosimus, in the fifth century of our era wrote χημεια, derived from χεω, or χευω (*to melt*, or *to fuse*); but there certainly is no warrant for using the *y*, since neither the Greek substantive nor the verb contains the *v* placed as this author would have it. As to the contents of the book, while admitting that there is in it a large amount of useful information, it is equally true that it is, in many respects, a curious *olla podrida*; and this especially applies to the attempt evidently made of compressing a great deal into a very confined space. On page 20, we read—"There are two kinds or classes of matter. Matter which has been formed by the action of animals or of plants, or which is part of an animal or of a plant, is called organic matter; because it is a part of the substance of the organs of the animal or of the plant, or is produced by these organs. Wood is an organic substance, because it is a part of the plant; starch is organic matter, because it is formed by the organs of the plant; flesh is organic matter, because it is part of the animal." It would seem that the author has no idea of the distinction to be made between *organised* and *organic* substances or matter. The book is by no means free from incorrect statements—*e.g.*, page 83 we read—"For chlorine cannot bleach mineral colours." How, then, does it act upon ultramarine, or upon Scheele's green? Of phosphorus, we read that it can be obtained in the free state only by artificial means; this is, of course, quite correct, but this equally applies to silicon, of which it is said it is not found in free state, while, according to the author, boron is not known in free state—a statement which is quite incorrect, for it may be obtained in the free state by artificial means just as well as phosphorus and silicon.

The appendix is the best, and, in many respects, most valuable part of the book, since in it are given the rules applying to decimal fractions, the decimal system of weights and measures, and the value thereof according to the English system. The author has, we fear, written rather hurriedly; and, by trying to compress too much information in a small space, sacrificed that clearness which should characterise a book of this nature intended for the great body of the people.

CORRESPONDENCE.

QUANTIVALENCE OF SODIUM, &c.

To the Editor of the Chemical News.

SIR,—From the letters of Mr. G. E. Davis, and Mr. Noel Hartley, which have recently appeared in the CHEMICAL NEWS, it would seem that these gentlemen consider that there is something quite new in regarding sodium, potassium, &c., as capable of acting as triads and pentads. Now, I respectfully submit that there is no great novelty in the matter; such views having been put forth by several chemists at various times, but, without going further into the subject, I will simply call attention to a paper which I wrote on this question (CHEMICAL NEWS, vol. xvi., p. 43, July 26, 1867), with the object of showing "that reputed monads may, under certain circumstances, play the part of triads and pentads. Indeed, anyone who considers such compounds as that of potassium with hydrogen and fluorine, KHF_2, and that of silver with hydrogen and iodine, $AgHI_2$, can hardly fail to regard one at least of the elements so combined as acting, for the time being, the part of a triad. Professor Wanklyn, however, is not content with regarding sodium as occasionally capable of triadic functions; he seems to argue that it is never a monad, and this extreme view appears to be quite untenable in the present state of science.

One word, in conclusion, with reference to the two classes into which Dr. Williamson has divided the elements, viz., those of even and uneven quantivalence, or, as Dr. Odling calls them, artiads and perissads; I believe that there is no hard and fast line between these two classes, and could produce evidence on this point, but will, at present, merely remark that quantivalence must be regarded as a state or condition of matter, and not as an unalterable property attached to this or that element.—I am, &c.,

JOHN A. R. NEWLANDS, F.C.S.

13, Knowle Road, Brixton, S.W.
February 28, 1870.

TREATING EXCRETA OF TOWNS.

To the Editor of the Chemical News.

SIR,—I have just been shown an article in the CHEMICAL NEWS of October 22nd, 1869 (vol. xx., p. 196), on "A Chemical Method of Treating the Excreta of Towns," by Edward C. C. Stanford, F.C.S. It may be interesting

to your readers to have a short description of the system of conservancy I have persistently been trying to introduce into India for the last eighteen months. I must premise that, in tropical climates, the evils of the water sewage are greatly increased. The water with which the sewers are flushed is hot; putrefactive fermentation takes place very rapidly, as, also, does fungoid vegetation. The system I propose is to carbonise the filth in retorts, and to utilise the gas for heating the furnace and for illuminating. The filth is thoroughly deodorised, by means of the poudrette coke (the residue left in the retorts), and can be carried in carts or open vessels to the carbonising apparatus. In order to obtain an extra quantity of gas for heating the furnace, I purpose either making the retorts reciprocating, or using double retorts, with mouthpieces, lids, and ascension-pipes at both ends; by this means, the charge of one retort, or of half a double retort, can be so arranged that the steam first given off will pass through and over the incandescent poudrette coke lying in the other half, or in the reciprocating retort, as the case may be. By this means, the steam becomes decomposed and forms two gases, hydrogen and carbonic oxide. There must be stop-valves in the ascension-pipes to carry out this arrangement. I have always insisted that the poudrette coke, surcharged with ordine, will give a highly-luminous gas. I am now preparing a project for the conservancy of the Cantonment of Dum-Dum, by order of the Viceroy in Council, and will send you full particulars of the result.

It may be thought that if the carbon be used to make carbonic oxide by decomposing the water, it will not be available as poudrette coke for deodorising fresh filth; but one, or a pair of retorts, loaded and so used, out of a group of five, will give sufficient gas for heating the furnace. For Dum-Dum, I propose having a group of five retorts (double), with a furnace-grate for coke at one end and a pipe passing in for gas at the other end through the back wall. There is a condenser, with a tank for collecting the tar and ammoniacal liquor; a dry-lime purifier, for getting rid of any carbonic acid; and a small gas-holder, for regulating the supply of gas to the furnace.—I am, &c.,

W. R. GILBERT HICKEY, C.E.

Calcutta, Feb. 1st, 1870.

MISCELLANEOUS.

Death of Dr. Redtenbacher.—We regret to have to announce the death of Joseph Redtenbacher, M.D., &c., Professor of Chemistry at the University of Vienna. The deceased was born on March 12th, 1810, at Kirchdorff (Austria), and held, since 1849, the Chair of Chemistry just alluded to. He was well known as the author of a large number of scientific memoirs and papers, and was a member of the Imperial and Royal Academy of Vienna from the date of its foundation, some forty years ago.

New Dictionary of Science.—Messrs. Moxon and Co. are preparing for publication a Dictionary of Science, edited by Mr. G. Farrer Rodwell. It will be uniform with Haydn's "Dictionary of Dates" and "Dictionary of Biography," and will comprise—Acoustics, Astronomy, Chemistry, Dynamics, Electricity, Heat, Hydrodynamics, Hydrostatics, Light, Magnetism, Meteorology, Pneumatics, Statics. These subjects will be treated of by—J. T. Bottomley, M.A., Lecturer on Natural Science in King's College School; William Crookes, F.R.S., &c., Frederick Guthrie, B.A., Ph.D., Professor of Natural Philosophy in the Royal School of Mines; R. A. Proctor, B.A., F.R.A.S.; Richard Wormell, B.A.; and the Editor.

Gold-Smelting in Irkoutsk, East Siberia.—MM. Basnin and Lomonossoff have opened a private laboratory, in Irkoutsk, for the technical study of the minerals, &c., of the country—*i.e.*, the determination of ores, salts, solutions, manures, and materials for building and heating (the determination of paraffin in asphaltum is included). The laboratories are large, and fitted up with all the necessary apparatus. The titration method will be exclusively used for technical analysis of useful minerals; as far as this method extends, MM. Lomonossoff and Basnin have promised to send us an account of the results of their labours from time to time.

A Soda Mine.—Some two miles north of the Sand Springs Road, and fifty miles east of Virginia and Gold Hill, is an immense and apparently inexhaustible deposit of almost pure soda. It is owned by parties in Carson and Virginia, who use it in the manufacture of soap, and also supply quartz mills with it as a chemical agent in the reduction of ores. They also supply it to drug and grocery stores, where it is sold for washing and other purposes for which common soda is ordinarily used. It is free from all earthy matter, and consists of 80 per cent soda, the balance being salt, or something of the sort. The deposit is in the midst of an alkali flat, of some 17 acres in extent, and at the surface it appeared only about 3 feet wide, or rather more like a soda spring than anything else, the pure article forming in a crust over and about the strong watery solution. Upon digging beneath this, however, the solid soda was discovered in a defined mass, like a quartz ledge. A shaft has been sunk beside it to the depth of 50 feet, from the bottom of which a drift has been made 25 feet into the vein or deposit of soda, without getting through it; in fact, very little is known of the depth or extent of this huge deposit of soda, except that there is apparently a million tons or more of it in sight. The enclosing walls on each side are very distinctly defined, and are simply composed of a dark, heavy, compact, iron sand, strongly impregnated with soda. This deposit is as singular as it is valuable, and goes to show how little the varied and inexhaustible resources of our young State are as yet developed.—*Gold Hill News.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, March 7, 1870.

This number contains the following papers and memoirs relating to chemistry and physical sciences:—

Electromotive Force of Divers Substances, as, for instance, Pure Carbon, Gold, Platinum, &c., in the Presence of Water and other Fluids.—E. Becquerel.—This paper contains the description of a series of very accurate experiments made with chemically pure substances. Among the curious facts elicited is this, that pure gold, obtained from the French Mint, is acted upon by pure water in a manner not hitherto explained, but which gives the author occasion to ask whether, possibly, gold does not contain another substance, which has not been discovered, or whether, perhaps, the slow action of the water is not the cause of the disaggregation of the gold, and thus explains the fact of its being found in rivers in the state of dust.

Elucidating Remarks on M. Charles.—J. Dupuis.—In the meeting of the 7th of February last, mention was made of some papers, manuscripts, and books presented to the Academy, formerly the property of the celebrated physicist, Charles. It appears that some confusion has arisen, since there have been two scientific men bearing this surname—viz., Jacques, born at Cluny, a celebrated mathematician, who died on the 22nd of August, 1791; and Jacques Alexandre César, born at Baugency, on the 12th of November, 1746, who died in 1823, and it is this latter celebrated physicist whose papers, memoirs, &c., have been accepted by the Academy for its library.

Observations of the Colours Exhibited by Rarefied Gases when Submitted to Spectrum Analysis.—J. Dubrunfaut.

Electromotive Force which Platinum Evolves when brought into Contact with Divers Liquids.—J. M. Gaugain.

Formation of Icicles.—Lecoq de Boisbaudran.—A paper illustrated with several woodcuts, absolutely necessary for it to be properly understood.

Illumination of Transparent Bodies.—M. Soret.

Absence of Oxygenated Water in the Snow Fallen at Rouen.—A. Houzeau.—This paper contains an account of very carefully executed experiments to detect the presence of peroxide of hydrogen (*eau oxygénée*) in water obtained from snow, care being taken to prevent the loss or decomposition of the peroxide alluded to. The author's opinion is that, since the experiments made at Kasan undoubtedly proved the presence of the peroxide of hydrogen in snow water, there may exist an essential difference, caused by the locality where it falls. Kasan is situated almost in the centre of the Russian empire, far away from any seas or oceans.

Poisoning with Hydrocyanic Acid and Cyanides.—M. Bonjean.—This paper contains a very interesting account of a series of experiments made with living animals, in order to establish positively whether, after their death, such substances as hydrocyanic acid and cyanides can be detected with perfect certainty by chemical analysis. The contents of the paper are too lengthy for full and useful abstraction, but deserve attention, especially for medico-legal questions.

Rain of Sand which occurred in Italy on the 13th and 14th of February last.—Rev. P. Denza, S.J.—This lengthy memoir contains the account of a very curious phenomenon—viz., rain, in the southern parts of Italy, accompanied by a fall of a fine reddish sand, while, in the northern parts of that kingdom, snow fell accompanied by the same substance. The sand has been tested, and found identical with that which is now and then carried by gales of wind from the African desert, not simply into Italy, but even sometimes into Switzerland, where some of it fell, along with snow, at Tscappina (Canton des Grisons). This paper contains many curious facts relating to a phenomenon which is sometimes observed also on the Canary Islands.

Action of Ozone upon Nitroglycerine, Dynamite, and other Explosive Substances.—J. Jouglet.—According to the author's experiments, nitroglycerine, dynamite, iodide of nitrogen, chloride of nitrogen, and some other similar compounds explode the very moment they are brought into contact with ozone; so that, for instance, a drop of nitroglycerine, introduced into a vessel containing ozone, causes an instantaneous explosion. Picrate of potassa gunpowder and ordinary gunpowder are slowly decomposed by ozone, a decomposition which, as regards the last-named substance, takes several weeks before it is perceptible.

Les Mondes, February 24, 1870.

Solar Temperature, and the Means by which it is Kept up.—Rev. A. Secchi, S.J.—The *resumé* of this memoir, originally published in the Italian language, is given in the following few lines:—The sun is a globe possessed of an enormously-high temperature, undoubtedly reaching many millions of degrees; but our means of estimating that temperature are very imperfect. As to the origin of this high degree of heat, it may have been the result of the force of gravitation which has united the elements of which the central point of the system (viz., of our solar) has been made up; the initial temperature, therefore, the result of mechanical action, will, of necessity, have been far greater than the present temperature of the sun is, which is certainly cooling down. However great this loss of heat may be, it is imperceptible to us, since it is slowly taking place, and partly compensated by chemical actions which take place in the sun, which is, in all probability, in its interior, a mass of strongly-compressed and condensed nebulous matter.

Handbook of General Cosmography.—H. J. Klein.—This is highly eulogised as a compendium explaining, in a clear and precise style, everything at present known of our solar system and its constitution. The author has followed, as pattern, the celebrated von Humboldt's *Cosmos*.

Cleansing of Raw Sugars, and Extraction of Sugar from Molasses, by means of the Saccharate of Hydrocarbonate of Lime.—J. Bolvin and T. Loiseau.—Under the name of *sucrate d'hydrocarbonate de chaux* (saccharate of hydrocarbonate of lime), the authors describe, but do not exactly define, a peculiar compound of lime-water and sugar, to which some peculiar properties are ascribed. The main gist of the paper is a lengthy account of an enumeration of the processes in use for refining sugar at the refinery of MM. Sommier and Co., La Villette, Paris, according to the system of the authors, but any one acquainted with sugar refining will at once perceive that the paper is vaguely worded, and that there is a want of precision in it.

Apparatus for Heating the Feed-Water for Steam Boilers.—H. N. Wateso.—This contrivance, which could not be well understood without the reproduction of the cut, is an ingenious arrangement, well deserving the attention of those who wish to save fuel. Emile Leroux, C. E. 43, Rue de Verneuil, Paris, gives full particulars on this subject.

Tungsten Blue.—Tessié du Motay.—Dissolve, in a sufficient quantity of water, and successively, 10 parts of tungstate of soda, 8 of tin-salt (protochloride of tin), 5 of ferrocyanide of potassium, and 1 of perchloride of iron. When all these substances are dissolved, the mixture is thoroughly stirred up, and the sediment which is formed is separated by filtration. As soon as the liquid has run off, the moist pasty matter is spread out in thin layers upon suitable glass plates, or shallow dishes, and for several days exposed to the action of strong daylight and sunshine. This slowly causes the formation of a beautifully-blue pigment; and this action may be accelerated by washing the material, so as to remove the matters soluble in water which it yet contains. The blue material has a great similarity with Prussian blue, but differs from it by not being bleached by sunlight; akin to Prussian blue, it resists the action of acids, but not of alkalies. The tungsten blue can be heated to about 180° without decomposition. Its percentage composition, in 100 parts, is—Water, 7·85; tin, 31·69; iron, 5·13; cyanogen, 19·41; blue oxide of tungsten, 35·60; total, 99·68. This blue is not affected by artificial light at all, and is sold at the same price as the very best quality of Prussian blue.

Oxyhydrogen Light.—Tessié du Motay.—A lengthy paper, setting forth chiefly matters of domestic economy, as regards the cost of this mode of illumination, and also detailing improvements made whereby the use of lime or zirconia cylinders is replaced by a suitable system of carburation of the hydrogen gas.

March 3, 1870.

Prize Questions Proposed by the Royal Belgian Academy of Sciences, at Brussels.—(We do not quote those belonging either to pure mathematics or natural history). The study of electrical induction currents, based, as much as possible, upon a new series of experiments to be made. A new series of researches to be made, with the view of establishing the chemical composition and the mutual relation existing between the albuminoid substances. A gold medal (value £40) will be given for a successful answer to the last-mentioned question, while the value of the gold medal to be given for the reply to the other question will be £24. Answers, written in Latin, French, or Flemish languages, to be sent, post-paid, to M. Guételet, the perpetual secretary, on or before June 1, 1871.

Prize Questions Proposed by the Bataafsch Genootschap (Batavian Philosophical Society) at Rotterdam.—We only quote such as belong to chemistry or allied sciences. Determination of the temperature of the water of the oceans at great depth, and in such localities (latitude and longitude) where these determinations have not yet been made; crystallographical examination of such organic compounds as are sufficiently developed to recognise the cleavage of the crystals; determine whether any parts of the sun's surface are possessed of a higher temperature than other portions thereof, and also whether the hotter portions are always the same; the experimental determination of the temperature of decomposition of several chemical compounds, and the estimation of the influence exercised thereupon by the presence of different other substances, and other conditions which may modify that temperature; with at least three liquids, the influence has to be determined which is exercised upon electrolysis when the electrolyte is submitted to pressure: verify, at the same time, whether the facts observed confirm the principle of the conservation of force. By a sufficient number of well-authenticated facts, the question should be settled whether steam boiler explosions are due to a formation of hydrogen gas (decomposition of water), or to the sudden conversion into steam of water previously converted into the spheroidal state; the estimation of the resistance to a galvanic current by liquid mixtures (amalgams in liquid state) of mercury and zinc, and mercury and gold, care being taken that the precise proportions of the metals mixed together, the sp. gr. of each mixture, and the thermo-electric properties such amalgams might possess, be simultaneously indicated; historico-critical account of the observations hitherto made of the electric currents produced in telegraphic wires by thunderstorms and Aurora Borealis. Answer to the question whether any other molecular variations than those produced by the increase of the temperature of bodies affect the rays of the spectrum peculiar to such bodies. Decisive experiments to be taken in order to settle the question between Dr. Tyndall and Prof. Magnus, concerning the greatest absorption of heat by air charged with aqueous vapours. Test, by a series of entirely new experiments, the truth of Dr. Gaugain's statement that conducted electricity is propagated through matter, while free electricity is propagated through the ether. What is the cause of the volcanoes of the Indian Archipelago? The precise estimation of the degree of solubility of gases in liquids, to be determined for at least four gases and eight fluids; the rules generally given for the placing of lightning conductors on buildings should be tested, if possible, by experiments and observations, and therefrom fixed rules established; the more extended study should be made of the conductibility of those electrical conductors termed, by Dr. Gaugain, imperfect conductors; theory, by confirmation, of Holtz's electrical machine; explanation of the phenomena of the spontaneously-becoming charged with electricity of electric conductors placed underground, or under water, and the means to prevent, or, at least, to neutralise, the effects thereof. For the best answers, a gold medal, value £15, or the money-value, with an additional premium of from £5 to £12; a silver medal for the next best answer. Answers written in Dutch, French, English, German, or Latin languages, accompanied by a sealed billet, bearing outside a motto, and inside the author's name, to be sent, post-paid, to Dr. F. van der Pant, at Rotterdam, on or before the 1st of February, 1870.

Measurement of Forces.—M. Coste.

Movement of the Sea.—J. Quenaut.—This author writes from Montmartin-sur-Mer, and, among other things, states that, according to authentic documents, the islands of Jersey and Guernsey have sunk down, during the lapse of the last 500 years, at least 13 metres.

Capital Punishment by means of the Guillotine.—Dr. E. Decaisne.—We simply quote the title of this paper, very opportunely published, since it contains full explanation and sound refutation of the nonsense which has appeared in print of late concerning the retention of vitality, and even consciousness, after decapitation by this machine, introduced in France in 1791.

March 10, 1870.

Candle-Bearing Tree.—This curious tree is only met with near the river Chagres, in the Isthmus of Panama, and was discovered there by Dr. Siemann. It is the fruit of this tree which so perfectly resembles, in shape and colour, that of unbleached wax candles, which has given rise to its popular name, *palo de velas* (candle tree); the botanical name is *Parmentiera cerifera*, and its fruit is eaten by sheep. The fruit known as quamxilotte, and eaten by the Mexicans as a delicacy, is produced by the *Parmentiera pendulus*.

Secreting Organ of, and the Secretion of Sulphuric Acid by, Gasteropode Molluscs.—Paolo Panceri.—Very little is at yet known about the chemical nature of the various fluids produced in and secreted by the non-vertebrated animals. The lengthy paper here quoted describes a very curious phenomenon of the mollusc known as *Dolium galea*, which sometimes grows to a very large size. The saliva of this animal is a colourless, somewhat opalescent liquid, of from 1·025 to 1·030 sp. gr., containing, in 100 parts—Free sulphuric acid, 3·42; combined sulphuric acid, 0·2; combined hydrochloric acid,

0·58; potassa, soda, magnesia, oxide of iron, phosphates, and organic matter, 1·8; water, 94·0. This paper contains, moreover, an anatomical and physiological account of the secretory organs of this animal.

Improved Coffee-Roasting Machine.—M. Marchand.—There is a woodcut annexed to the description of this contrivance, which has been very favourably reported upon by a committee of the Chemical Department of the Société d'Encouragement de l'Industrie Nationale.

Revue des Cours Scientifiques de la France et de l'Etranger, March 5, 1870.

From this number, which does not contain any papers relating to chemistry or allied sciences, we learn that M. Delaunay has been appointed Director of the Imperial Observatory at Paris, in lieu of M. Le Verrier.

The Elsass during the Tertiary Period.—J. Delbos.—An interesting geological paper.

Cosmos, March 5, 1870.

Heating of Steam Boilers.—A. Scheurer-Kestner and E. Meunier.—The authors have made, on the large scale, a series of experiments which prove that only about 60 per cent of the heat given off by the combustion of coals is really utilised, and the loss is due to the radiation of the exterior surfaces of the boilers. The authors are of opinion that improvements should be directed towards the prevention of this loss of heat; they, moreover, find that the cleaning of the inside of the boilers has great influence, and suggest that this operation of cleaning should be done at short intervals of time.

Preservation of Milk.—Add to every litre (1¾ pints, and 5 oz.) of unskimmed milk, previously poured in a well-annealed glass bottle, 40 centigrms. (about 6 grs.) of bicarbonate of soda. Place the bottle containing the milk, and well corked, for about four hours in a water-bath heated up to 90° (194° F.). On being taken out, the bottle is varnished over with tar: and in that state the milk it contains will keep sound and sweet for several weeks.

Large Fir Tree.—There has been just cut down, at Arwa, in Hungary, a fir tree, 139 ft. high, and 71 inches in diameter at 2 ft. from the soil. This tree, as regards size, is a specimen now very rarely met with in Europe, though more common to America.

Solid Bisulphide of Carbon.—Dr. von Wartha.—This has been obtained by the rapid evaporation of this liquid itself in the same way as solid carbonic acid is formed. The solid sulphide melts at 9° F., and has the appearance of small cauliflowers.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 145,

This number, and the following (No. 146), do not contain any original papers relating to chemistry or allied sciences.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, November, 1869.

The only paper relating to chemistry in this number is a lengthy memoir:—

Contribution to the History of the Sulphuretted Urea.—Prof. A. W. Hofmann.—This memoir contains the following subsections:—Desulphuration of the ethyl-sulpho ureas; desulphuration of the diethyl-sulpho ureas; desulphuration of diethyl urea in the presence of ethylamine; desulphuration of diethyl-sulpho urea in the presence of ammonia; desulphuration of monoethyl-sulpho urea; desulphuration of normal sulpho urea.

Annales du Génie Civil, February, 1870.

This number contains a paper on the—

Utilisation of the Heather.—E. Dromard.—In France, and in a great many other European countries, very large tracts of land are uncultivated and left waste, producing nothing but heather and similar plants. The author's lengthy memoir describes practical methods whereby these plants are employed for the production of charcoal, acetic acid, tar, and other useful products, and the soil so cleared as to become fit for the cultivation of various kinds of fir trees. The contents of this paper are of great interest to agriculturists and landowners.

Pharmaceutische Zeitschrift für Russland, December, 1869.

The only original paper contained in this number is the end of the extremely lengthy memoir—

Monograph on Inuline.—Dr. Dragendorff.

Journal fur Gasbeleuchtung, January, 1870.

Although not directly bearing upon the matters generally treated in our journal, we call attention to an excellent paper, illustrated with a series of beautifully-executed engravings, on the—

Application of Gas Illumination to Theatres.—L. Diehl.—Considering that these buildings so frequently become the prey of flames, occasioning serious loss of life by their conflagrations, this paper is of great interest to all concerned in such matters.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 4, 1869.

This number contains—

Contribution to the Mineralogical Topography of Austria and Hungary.—F. von Vivenot.—This useful and concise catalogue is alphabetically arranged, as far as the minerals are concerned, while the names of the localities are printed in italics.

Polytechnisches Journal von Dingler, second number for January, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

Possible Causes of Steam-Boiler Explosions.—Dr. H. Schröder.

Bessemer Steel and Heaton Steel Processes.—T. Schinz.

Colorimetric Carbon-Test of Eggertz.—Dr. Dingler.—The result of the author's researches on this subject is, that Eggertz's process is only applicable when the same quantities and qualities of raw materials are continuously applied for the production of cast-iron; but the test fails to give good results with iron and steel of different origin, since it has been found that the presence of other substances—viz., sulphur, copper, phosphorus, and silicium—affect the accuracy of the test.

Chemical Constitution of the Colouring Matter of the Alder Tree.—F. Dreykorn and E. Reichardt.—It is a well-known fact that the wood of the *Alnus glutinosa, L.*, when recently cut, exhibits a series of colourations, rapidly changing from yellow to reddish brown. The authors isolated this colouring matter, which is perfectly insoluble in ether, benzol, and sulphide of carbon, difficultly soluble in absolute alcohol and boiling water, but readily soluble in dilute alcohol in every proportion. The different tests applied to this substance resulted in defining it as a peculiar tannin material; with gelatine solution, it is precipitated, with chloride of iron it yields a green precipitate, and its combinations with the heavy metals are insoluble in water; its formula is $C_{54}H_{28}O_{23}$. This material yields, when split up by the action of sulphuric acid, sugar, and a peculiar reddish brown-coloured resinous substance, insoluble in water and ether, difficultly soluble in alcohol, readily soluble in caustic soda solution and in ammonia, from which solutions it is precipitated again by acids. The splitting-up of the substance is represented by—

$$3(2HO,C_{54}H_{28}O_{20})+HO=3(2HO,C_{46}H_{17}O_{11})+2(C_{12}H_{14}O_{14}).$$

The memoir describes further, at length, the action of alkalies upon this alder tannin, and the products of the dry, or destructive distillation. The result of these researches is that, by the action of alkalies, there are formed protechusic acid, phloroglucine, and acetic acid. The dry distillation yields pyrocatechine.

Manufacture of Fatty Acids from the Washing of Wool and the Soap-Suds Thereof.—Dr. Dingler.—After referring briefly to the researches of Houzeau Muiron on this subject, the author discusses, at great length, this topic; and the chief result is that a material is obtainable, by suitable treatment of the wash-waters of wool, which contains, after the bulk of the water has been removed by pressure, in 100 parts—Water, 10·66; fatty matters, 34·74; sundry organic matters, 22·37; fine sand, 30·32; soluble silica, 0·08; sulphuric acid, 0·28; phosphoric acid, 0·09; oxide of iron and alumina, 0·99; lime, 0·25; magnesia, 0·10; alkalies, 0·12. This material has been applied for the manufacture of gas, 100 lbs. of it yielding 469·25 cubic feet free from sulphur compounds and of far greater illuminating power than good coal gas. The fatty matters can be extracted, if desired by means of sulphide of carbon.

Journal de Pharmacie et de Chimie, February, 1870.

This number contains the following original papers:—

Sulpho-Carbonic Extracts, and their Application in the Preparation of Medicinal Oils.—J. Lefort.—This is strictly a pharmaco-technical essay, treating, under several separate divisions, on the preparation and properties of extracts (from various medicinal plants) by the employment of sulphide of carbon (refined, of course), and the further application of the extracts thus obtained, to the preparation of medicinal oils.

Adulteration of Cochineal.—E. Baudrimont.—The author states that the more common kinds of this dye material are first softened and swollen, by means of steam, and next rolled about in artificial sulphate of baryta, whereby the substance assumes the appearance of a superior article. The fraud can, however, be readily detected, since, in the first place, the genuine article contains only from 4 to 6 per cent of water, and this mode of adulteration increases that quantity to 11 per cent; secondly, the quantity, as well as the quality of the ash, is entirely changed. The author found from 19·5 to 20 per cent of sulphate of baryta in the ash, which, when no adulteration has been attempted, contains no trace of this salt.

Poisoning with the Berries of the Honeysuckle.—Dr Duval. That this plant is rather dangerous, on account of its poisonous properties, is well known, but the climate it is cultivated in has some modifying influence. The case here related did not end fatally.

Indian and China Isinglass.—J. L. Souberain.—The author states that the different varieties of this article, as met with in the trade, may be recognised as follows:—Russian isinglass dissolves rapidly and instantaneously in hot water, leaving hardly ever more than at most 2 per cent insoluble residue; Bengal isinglass dissolves readily, but leaves from 7 to 13 per cent of residue. The taste of Russian isinglass is pleasant and sweet; it yields a very firm gelatine, which is perfectly transparent. The Bengal, or Indian kind, often has a fishy taste, and the gelatine it yields is not clear. The Brazilian isinglass yields an opaque, milky-looking gelatine, and its taste is acrid. China isinglass is a rare article in the European markets.

Journal für Praktische Chemie, No. 19, 1869.

This number, which, it should be observed, was published only by the end of last January, in consequence of an interruption having taken place by the death of the editors, as well as the publisher, of this periodical, contains the following original papers and memoirs:—

On the Iodated Salicylic Acids, Oxysalicylic Acid, and Hypogallic Acid.—Dr. P. Liechti.—In the introduction to this memoir, the author refers to the researches of others on this subject, and states that, as regards the solubility of salicylic acid in water, one part thereof requires, at 10°, 2500, at 18°, 1818, and at boiling temperature, from 15 to 20 parts of that fluid for solution. Monoiodsalicylic acid—

$$C_7H_5IO_3 = C_6H_3I \begin{cases} CO.OH \\ OH \end{cases}$$

a crystalline substance, anhydrous, and fusing at 184°, but when covered with water, at 98°. One part of this acid requires, at 20°, 893, and at 100°, 104 parts of water for solution. The solutions of this acid and of its salts yield, with chloride of iron, a brilliant violet colouration. The acid contains 48·2 per cent of iodine. Several of the salts of this acid are described at length. Di-iodsalicylic acid—

$$C_7H_4I_2O_3 = C\ H_2I_2 \begin{cases} CO.OH \\ OH \end{cases}$$

a semi-crystalline mass, anhydrous, soluble in 1428 parts of water at 15°, and 656 parts at 100°; readily soluble in alcohol and ether; and becomes decomposed when heated to about 197°. The reaction with chloride of iron is the same in this instance as just alluded to. It contains 65·2 per cent of iodine. Among the salts of this acid, the baryta salts are the most interesting. Oxysalicylic acid—

$$C_7H_6O_4 = C_6H_3 \begin{cases} CO.OH \\ 2OH \end{cases}$$

The author says that, notwithstanding there exists a great similarity between this acid and hypogallic acid, he does not think that these substances are identical. Oxysalicylic acid requires 58·7 parts of water at 21° for its solution, but is readily soluble in boiling water; fusion point, 183°. Even in the cold, this acid reduces an ammoniacal silver solution. The preparation of the oxysalicylic ether is described at great length. In pure state, this substance is a solid crystalline material, fusing at 78°, readily soluble in alcohol and ether, and difficultly so in water. This solution reduces neutral nitrate of silver to the metallic state, even in the cold, and yields, with acetate of lead, a precipitate soluble in acetic acid. Bichloride of mercury is not at all affected by contact with this substance, which also yields with chloride of iron a beautifully deep blue-coloured solution. Opinic and isopinic acids are next described, and the author's researches, compared with those of Drs. Matthiessen and Foster on this same subject. According to Dr. Liechti, opinic and isopinic acids are peculiar modifications of hypogallic acid.

Action of Permanganate of Potassa upon Quinine.—Dr. G. Kerner.—One part of pure quinine is dissolved in excess of nitric or hydrochloric acid in such a manner that a bulk of 100 c.c. contains about 1 grm. of the alkaloid; this solution is heated to between 50° and 60°, and there is then added to it a concentrated solution of two parts of crystallised permanganate of potassa in water, care being taken to keep the fluid well stirred. After removal of the peroxide of manganese, the liquid (which should have an alkaline reaction) is evaporated to about one-eighth of its previous bulk, and next acidified, whereby the newly-formed product of oxidation is precipitated. After having been purified, by frequent re-crystallisation from water, aided, for the removal of some colouring matter, by animal charcoal, a hard crystalline substance is obtained, difficultly soluble in cold water and alcohol, but more readily so in these liquids at their boiling temperature. In many respects, excepting taste and alkaline reaction, this substance exhibits properties very similar in character to those of quinine. The formula of this body, which is dihydroxyl-quinine, is $C_{20}H_{22}N_2O_2 + 4H_2O$, and its formation from quinine is represented by $C_{20}H_{24}N_2O_2 + H_2O + O = C_{20}H_{22}N_2O_4$.

Action of Fremy's Osmiamide upon Animal Tissues.—Ph. Owsjannikow.—This paper is devoted to the description of the action of Fremy's osmiamide upon tissues—viz., for microscopico-histological use, and has nothing to do with chemistry. What Fremy's compound is meant is not stated.

NOTES AND QUERIES.

Anthracene.—I should be glad to have a simple test for commercial anthracene, and its price, to see whether it would be worth while to make it where pitch is of little value?—TAR DISTILLER.

Coprolite and Bone in Mixed Superphosphates.—(Reply to "W. M. B."—When both the bones and coprolites have been thoroughly dissolved, it will be almost impossible to determine what you desire. If no ammonia salts are present, and the bones applied not too strongly boiled (exhausted by steam), you might (after drying, of course, at 120 °C.) get some idea by means of the nitrogen estimation.

Estimating the Amount of Lamp-Black in Graphite.—(Reply to J. Reddropp.)—In the first place, you might make use of the considerable difference of specific gravity of these two substances, and thus separate them from each other by lixiviation. Since lamp-black (unless purposely purified or re-calcined) always contains a certain amount of empyreumatic matter, you might extract the graphite you suspect with boiling alcohol (methylated spirit will not do in this case), and come to some idea of the amount of lamp-black added to your graphite by the weight of the empyreumatic matter left after complete exhaustion with alcohol and evaporation of the latter. When completely exhausted, an aqueous solution of boiling caustic soda should not, after the graphite (supposed to be mixed as alluded to) has been quietly settled down, exhibit any sign of brownish or yellowish brown colouration.

Manufacture of Sulphuric Acid.—The following practical objections to Dr. Hofmann's paper, abstracted by you from the *Berichte der Deutschen Chemischen Gesellschaft*, are suggested by my experience, and I should like to elicit the opinions of others who have had experience in that manufacture. If the steam is regulated so as to make the acid of 1·676 to 1·714 sp. gr., as Dr. Hofmann proposes, there is so much nitric oxide dissolved in it as to act very energetically on the lead of the chamber, the liquor in the guage-drips becoming thick with sulphate of lead, whilst, as a consequence, the chamber wears out very rapidly. At the same time, if the condensed acid in the saucer of the chamber is drawn off at such a high specific gravity, I find that the dissolved nitric oxide is not got rid of by the subsequent boiling, but that the concentrated oil of vitriol gives off abundant red fumes when diluted, causing great inconvenience to those who use it, and, of course, a waste of nitric acid.—H. B. GIBBINS.

Analysis of Superphosphates.—Perhaps some of your numerous correspondents would explain to me how it is that, in the analysis of superphosphates and other phosphatic manures, biphosphate of lime is put down as one of the ingredients it contains, and generally underneath it is placed equal to so much phosphate of lime made soluble. Now, I always understood there was no such substance as bisphosphate of lime in a superphosphate, but that the phosphates it contained existed as monocalcic phosphate or soluble phosphate, and tricalcic or insoluble phosphate, and not as biphosphate. If such is the case, why not simply put in the analyses the amount of soluble phosphate, or, if I am wrong, the amount of biphosphate, and not put both? This would simplify matters greatly, as, at present, people that have only a limited knowledge of chemistry are very apt to confound the one with the other, not knowing the difference between them.—R. HOLMES, Roscommon, Ireland.

MEETINGS FOR THE WEEK.

MONDAY, 21st.—Medical, 8.
—— London Institution, 4.
TUESDAY, 22nd.—Royal Institution, 3. Prof. Rolleston, on "Nervous System."
—— Institution of Civil Engineers, 8.
—— Ethnological, 8.
WEDNESDAY, 23rd.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 24th.—Royal Institution, 3. Prof. Odling, "Chemistry."
—— London Institution, 7.30.
—— Royal, 8.30.
—— Zoological, 8.30.
—— Royal Society Club, 6.
FRIDAY, 25th.—Royal Institution, 8. Prof. Rolleston, "Anglo-Saxon Conquest."
—— Quekett Microscopical Club, 8.
SATURDAY, 26th.—Royal Institution, 3. Mr. Lockyer, "The Sun."

TO CORRESPONDENTS.

ERRATUM.—In Mr. Hartley's paper, on page 110 of our last number
For—

$$N\left\{\frac{(CH_3)_4\ (CH_2)_4}{(I_{10})''}\right\}N$$

read—

$$N\left\{\frac{(CH_2)_4\ (CH_3)}{(I_{20})''}\right\}N.$$

Prof. J. Lawrence Smith.—The receipt of your letter was acknowledged in our columns, and your request has been attended to by our publisher.

Inquirer.—The unabridged edition of "Fresenius" is evidently the best.

M.R.C.S.—Calley's "Practical Telegraphy" will answer your purpose well.

C. R. Stevens.—A work on Dyeing, by the Editor of this paper, is in the press.

C. A. Grant.—(1) We do not know the names and addresses of makers of liquid fuel. (2) The Society of Arts, John Street, Adelphi. (3) We have no printed documents; consult *Engineer* or *Engineering*.

A Subscriber.—The subject is not suitable for our Notes and Queries column; you had better advertise for the information.

THE CHEMICAL NEWS.

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EXPERIMENTS ON SOME OF THE METHODS FOR EFFECTING THE SEPARATION AND ESTIMATION OF ARSENIC AND COPPER.*

By E. W. PARNELL.

PROBABLY the oldest and most universal method for effecting the separation of these metals is to treat the mixed sulphides with a solution of an alkaline sulphide, in which the sulphides of arsenic are soluble. Another method is to treat the sulphides with a solution of caustic soda or potash, and conduct a slow stream of chlorine gas into the mixture: the arsenic forms arseniate of soda soluble in water, while the copper is in the form of an insoluble oxide. A third method is to conduct a slow stream of chlorine gas over a mixture of the two metals, sulphides, or otherwise, heated by the flame of a Bunsen's burner: volatile arsenic-chloride is formed, which, when received in water, forms arsenic and hydrochloric acids; the copper remains behind. Another method is to convert all the arsenic into arsenic acid, by treatment with nitric acid or otherwise; add excess of ammonia, and throw down the arsenic as a double arseniate of ammonia and magnesia by the "magnesia mixture;" the copper remains in solution.

The author has attempted to show, by the following experiments, how far accurate results may be obtained by these and other methods of separating the metals, and also by the methods generally used for their estimation.

The Separation of the Metals.

A pure solution of copper was prepared, by dissolving pure, re-crystallised copper-sulphate in distilled water. Pure, freshly-sublimed arsenious oxide was dissolved in a boiling solution of sodium carbonate, to form an arsenic solution. Mixtures of these two solutions were used for experimenting on the methods of separation.

Treatment of the Metallic Sulphides with an Alkaline Sulphide.

A mixture was made from the above solutions, containing about 0·3 grm. of each of the metals. Excess of hydrochloric acid was added, the metals thrown down by sulphuretted hydrogen, the mixed sulphides introduced into a flask, covered with a colourless solution of sodium sulphide, and maintained at a gentle heat on the water-bath for about twelve hours. The liquid was then filtered off, the filtrate separated, and the copper-sulphide on the filter washed with boiling water, to remove every trace of soluble arsenic. The copper-sulphide was then dissolved in nitric acid, the solution evaporated with a small quantity of sulphuric acid, the residue dissolved in water, again treated with sulphuretted hydrogen, the precipitate treated as before with perfectly pure sulphide of sodium, and filtered. The clear solution that would have contained any arsenic that had remained with the copper in the first instance was decomposed with hydrochloric acid, the precipitated sulphur collected, washed, and treated with ammonia, which would dissolve any sulphide of arsenic that might be mixed with it. A little sodium-carbonate was added to the ammoniacal solution, and the liquid evaporated to dryness in a small porcelain dish, the residue mixed with a little potassium cyanide, and the mixture examined for arsenic, by heating it in a glass tube in a slow stream of carbonic acid, in the manner described in Fresenius's "Qualitative Analysis" (German edition, p. 180). A very faint mirror of metallic arsenic was obtained, that could not exceed 1-10th of a milligramme.

The filtrate from the first treatment with sodium sulphide was next decomposed with hydrochloric acid, the precipitate thoroughly washed and dried, and carefully sublimed. No trace of copper remained as a residue. From this, therefore, I conclude that a satisfactory separation can be effected by using a colourless solution of sodium sulphide.

The fact of ammonium sulphide dissolving small quantities of copper sulphide being so well known, the author did not consider it necessary to experiment on this method.

Separation by Conducting Chlorine Gas into an Alkaline Solution in which the Sulphides are Suspended or Dissolved.

A mixture was made, as in the preceding experiment; excess of a solution of potash was added, and a slow stream of chlorine conducted into the liquid until the latter was thoroughly saturated with the gas. The mixture was then boiled, filtered, the insoluble part well washed, and the precipitate and filtrate examined respectively for arsenic and copper, as in the previous examination. The copper was perfectly free from arsenic; but the filtrate contained a small quantity of copper (this was, however, probably due to minute particles of the oxide of copper being carried through the filter, as the oxide was in an exceedingly fine condition: the quantity was very small). Care should be taken to ensure a decided excess of the chlorine, or a considerable quantity of arsenic may remain with the copper. I conclude, therefore, that this method can yield accurate results.

Separation effected by Heating the Mixture in a Stream of Chlorine Gas.

A similar mixture to those used in the previous experiments was prepared, excess of hydrochloric acid added, the metals thrown down by sulphuretted hydrogen, the precipitate thoroughly dried and introduced into a bulb-tube, and the separation proceeded with precisely as described in Fresenius's "Quantitative Analysis." A large quantity of copper was found to be carried over with the arsenic into the condensing-tube; this would indicate that the heat had been far too high. The next step was to discover at how low a temperature all the arsenic could be decomposed and volatilised. With this object, about 1·0 grm. of pure arsenious trioxide, placed in a small porcelain boat, was introduced into a glass tube; this latter passed through an air-bath, fitted with a thermometer to enable the tube to be maintained at a fixed temperature. A slow stream of chlorine gas was conducted through the tube. In about twenty minutes, the arsenic was entirely converted to an oily-looking, yellow liquid—no doubt the terchloride. The temperature of the bath was then raised to and maintained at 100° C. In about half-an-hour, the liquid was entirely volatilised.

About 1 grm. of sulphide of copper was next treated in a similar manner with a cold stream of chlorine gas. The black mass quickly became yellow. In about an hour it was examined for sulphide, by treating a portion of it with water. A considerable quantity remained undecomposed. The temperature of the bath was then raised to 100° C., and the stream of chlorine conducted, as before, over the mass. After half-an-hour it still contained sulphide. The temperature was then raised to 150° C., and the stream of chlorine continued. After four hours the sulphide was not decomposed. In these experiments, the chlorine gas had not been thoroughly dried by passing it through a tube containing chloride of calcium. It occurred to me, therefore, that the small quantity of moisture the gas would contain might retard its action on the sulphide. To discover if this were the case, a similar

* Communicated by the Author. Conducted in the Laboratory of Professor Fresenius, Wiesbaden.

quantity was taken, very carefully dried, and treated as before with a stream of the cold, but now thoroughly dried, gas. In about half-an-hour, a portion of the sample was examined for sulphide; it contained only a very small quantity. The action was continued in the cold for about 1½ hours, a minute trace still remained; on warming the tube to about 150° C., and continuing the chlorine stream, this trace quite disappeared.

A mixture of copper and arsenic was then again prepared from the solutions, converted into sulphides as before, filtered, washed, and thoroughly dried. The mixture, contained in a porcelain boat, was introduced into the glass tube. This tube was allowed to project for about 4 inches beyond the air-bath. Perfectly dry chlorine was then conducted over the mixture, maintained at a temperature of about 200° C. In about half-an-hour the action was stopped. The projecting part of the tube, which had been almost cold during the operation, was examined for copper. It contained no trace. The copper in the porcelain boat was found to be completely soluble in weak hydrochloric acid. The solution was precipitated with sulphuretted hydrogen, the precipitate treated with sodium sulphide in a warm place for about four hours, the mixture filtered, and the filtrate carefully examined for arsenic, as before. It did not contain the slightest trace. I gather, therefore, from these experiments that, if proper precautions be taken to ensure perfect dryness of the mixture and the gas, a most perfect separation can be effected at a temperature of about 200° C. To avoid the formation of the globule of sulphur, or mixture of chloride of sulphur and sulphur, which often takes place in the condensing-tube, the precaution should be taken to first saturate the liquid with chlorine, or to use a solution of chlorine for the condensing-liquid.

Separation by Igniting the Mixed Sulphides in a Stream of Hydrogen Gas.

This process, conducted in the usual manner, has only for its object the estimation of the copper, unless, indeed, the amount of sulphur in the mixed sulphides is accurately known, when the amount of arsenic may be calculated from the loss.

To effect the separation, the mixture is introduced into a small porcelain crucible, fitted with a perforated cover and tube for conducting in the gas. A little sulphur is added, a gentle stream of hydrogen conducted into the crucible, and the mixture carefully heated by the lamp, and finally raised to bright redness. A mixture of the two metals was thrown down, as before, with sulphuretted hydrogen, and ignited as just described. The subsulphide of copper was subsequently very carefully examined for arsenic; it did not, however, contain the slightest trace.

Experiments on the Methods for Estimating Arsenic.

About 3·5 grms. of pure, dry arsenious oxide were carefully sublimed in a slow stream of dry air. This resublimed arsenious oxide was then weighed, (it equalled 2·4090 grms.), and dissolved in a boiling solution of carbonate of soda. I purposed diluting this solution to a certain volume, and measuring off portions for the various estimations. To ascertain the extent of the error that this mode of procedure would introduce, the following experiment was made:—A flask of about 300 c.c. capacity, with rather a narrow neck, was carefully marked, and filled to the mark with distilled water. The water in the flask weighed 281·51 grms. 20 c.c. of the water were then measured off, by a pipette, into a small, weighed beaker. The pipette was allowed to drain for about half-a-minute, resting against the side of the beaker, immediately above the liquid..

The weight of water was found to be—

	grms.
In the first trial	20·037
In the second trial	20·032
In the third trial	20·035
Average of the three trials ..	20·034

The greatest difference was 3 milligrammes, equivalent to 0·015 per cent. The extent of the error was, therefore, exceedingly small. The solution of arsenious oxide was introduced into the flask above mentioned, diluted to the mark on the neck, and the temperature noted. 20 c.c. of the solution contained, therefore, 0·17145 grm. arsenious oxide.

Estimation by Precipitation as Double Arseniate of Magnesia and Ammonia.

This mode of estimating arsenic (and, indeed, most others) necessitates the use of a weighed filter. The filter is first thoroughly dried in the water-bath, and usually allowed to cool between a pair of well-fitting watch-glasses. In this manner, it is very difficult to get accurate results: though the watch-glasses may fit very perfectly, the weight of the filter will rapidly increase after being taken out of the exsiccator.

To more perfectly protect the filter from external moisture, the holder about to be described was substituted for the watch-glasses. A test-tube of about 18 m.m. diameter was cut off about 10 centimetres from the closed end. A second test-tube was then selected, which fitted tightly over the first. The latter was then melted at a convenient distance from the end, and closed, so as to form a small and almost air-tight cover for the first tube. A dry filter, held in the old manner, between watch-glasses, absorbed, in a few hours, 14 milligrammes; while a filter in the holder described, in the same position, and in the same time, had absorbed only 0·6 milligramme.

Twenty c.c. of the arsenious-acid solution were measured off into a small beaker, neutralised with excess of acid, and chlorine conducted into the solution to strong excess. Ammonia was then added, and the arsenic acid precipitated by the "magnesia mixture," and proceeded with precisely as described in Fresenius's "Quantitative Analysis." The filter and precipitate were dried for two or three hours, at a temperatnre of 110°.

	grms.
Holder + filter + precipitate weighed	8·1970
Holder and filter	7·8892
Double arseniate	0·3078
Correction for filtrate (101 c.c.)	0·0063
	0·3141
Equivalent to arsenious acid	0·1636

A result which is far too low.

Twenty c.c. were treated precisely as before, but with additional care, to ensure the complete oxidation of the As_2O_3 to As_2O_5. The precipitate was dried at 110° C. until the weight remained constant.

	grm.
The precipitate weighed	0·3095
Correction for filtrate (93 c.c.) ..	0·0058
	0·3153

A result still very much too low.

A third quantity was measured off, and this time was oxidised by conducting chlorine gas into the alkaline solution without addition of hydrochloric acid.

	grm.
The weight of the precipitated arseniate (together with corrections for the filtrate) equalled.. ..	0·3244
Equivalent to arsenious oxide	0·1690

A result still too low.

Another portion was measured off, and proceeded with precisely as the last. The precipitate corresponded to 0·1670 grm. arsenious acid—a result still unsatisfactory.

The irregularity of these results led the author to conclude that either the correction for the filtrate is incorrect, or that the formula $(AsO_4,Mg,NH_4),2H_2O$ does not represent the composition of the compound after being dried at 100°—110° C. To discover if the former were the case, a

filtrate from one of the previous estimations, measuring 76 c.c., was neutralised with hydrochloric acid, and treated at a gentle heat for some hours with a slow stream of sulphuretted hydrogen, until all the arsenic was completely precipitated. The precipitate was filtered off, washed, dried, treated with CS_2 to remove any free sulphur that might be present, and weighed. The weight equalled 0·0019 grm., corresponding to 0·0029 of the magnesia precipitate. The correction usually made (namely, 1 milligramme for every 16 c.c.) would indicate a larger quantity than this, namely, 0·0047 grm.; so that an error from this source would render the result too high, instead of, as the case is, too low.

To discover the composition of the magnesia precipitate after being dried at 110° C., the pure precipitate was prepared in the following manner:—A quantity of pure arsenious oxide was powdered, and treated with strong nitric acid, to convert it into arsenic acid. The acid liquid was neutralised with ammonia, diluted, and precipitated with a solution of magnesium sulphate, care being taken to avoid an excess of the latter. The precipitate was well washed, first by decantation, subseqently on a large filter, with pure distilled water, and then thoroughly dried over sulphuric acid. A portion of it (about 1 grm.), further dried for thirteen hours over sulphuric acid, lost 0·0002 grm.

1·6822 grm. was dried at a temperature of 100° C. for three hours. It lost 0·6319 grm. For two hours longer, it had lost 0·6329 grm. The total loss amounted to 37·62 per cent; theory would lead us to expect only 34·25.

0·6059 grm. was then dried in the water-bath, the temperarure of which, however, was not much above 90° C.

	grm.		per cent.
After 12 hours it lost..	0·2020	=	33·34
,, 18 ,, ,, ..	0·2036	=	33·59
,, 24 ,, ,, ..	0·2054	=	33·80

No further decrease in weight took place.

1·0152 grms. were again heated in the air-bath.

	grm.		per cent.
4 hours at 100°—107° C. lost	0·3745	=	36·88
,, ,, ,, 105°—110° ,, ,,	0·3867	=	38·10
3 ,, ,, 105°—110° ,, ,,	0·3927	=	38·60

All of which are much above the theoretical loss.

The next step was accurately to ascertain the composition of the precipitate, dried over sulphuric acid. For this purpose, 1·0894 grms. were dissolved in hydrochloric acid, the arsenic precipitated with sulphuretted hydrogen, and filtered off; the filtrate concentrated, neutralised with ammonia, and the magnesia thrown down in the usual manner as a phosphate. The magnesia found equalled 13·92 per cent; the salt should theoretically contain 13·84.

To estimate the amount of ammonia in the salt, 0·2656 grm. was distilled in a small flask with caustic potash, and the escaping ammonia collected in a measured quantity of standard sulphuric acid, the excess of which was subsequently estimated by a standard alkaline solution. The sample contained 8·92 per cent; the theoretical proportion is 8·95 per cent. From these two determinations, I concluded that the formula $PO_4,Mg,NH_4,6H_2O$ correctly represented its composition.

It is well known that the error caused by heating the sample too highly is due to ammonia which escapes. The next experiment was to discover at what temperature the ammonia commences to be evolved. About 2 grms. of the precipitate, in a small porcelain boat, were introduced into a glass tube, so arranged as to be heated by an air-bath to any desired temperature. Air was drawn, by an aspirator, first through the tube, and then through a few cubic centimetres of pure water, slightly coloured with neutral litmus. The temperature had not been raised above 80° C., when ammonia manifested itself by changing the colour of the litmus. A weighed quantity was next operated upon, the tube being heated by a water-bath, and the escaping gases conducted through a small quantity of standard sulphuric acid. In about an hour, the sample had lost 5 per cent of ammonia. I therefore conclude that, at a temperature of about 90° C., ammonia escapes, but more than 1 equiv. of water is retained; while, at a temperature of from 100° to 110° C., this excess of water, and probably more ammonia, are driven off; and I therefore consider that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for a counterpoised filter. By heating the precipitate strongly to obtain AsO_4,Mg, arsenic invariably escapes. A plan was tried of first evaporating the precipitate with nitric acid before ignition, with a view to form ammonium nitrate, and prevent the reduction of the arsenic; but a loss still took place. Tolerably accurate results may be obtained by dissolving the precipitate in hydrochloric acid, precipitating the arsenic with sulphuretted hydrogen, and weighing it as As_2S_5. The salt, by this method, contained 25·78 per cent, instead of 25·90 per cent. This sulphide cannot be reduced to As_2S_3 by treatment with CS_2, which leads one to conclude that it is a penta-sulphide, and not, as some maintain, a mixture of As_2S_3 and free sulphur.

Estimation of Arsenious Oxide by Precipitation as Sulphide.

Twenty c.c. of the arsenious-acid solution were measured off, neutralised with hydrochloric acid, and the arsenic thrown down as tersulphide by sulphuretted hydrogen. The excess of the latter reagent was expelled by conducting carbonic acid into the liquid. The sulphide was collected on a tared filter, washed, and dried at 100° C. until the weight remained constant. The sulphide weighed 0·2114 grm., equivalent to 0·1701 grm. AsO_3.

Another 20 c.c. were treated in precisely the same manner. The sulphide weighed 0·2116 grm., equivalent to 0·1703 As_2O_3.

These two results agree together very closely, but are both slightly too low. Probably, if the precaution were taken to avoid a great excess of hydrochloric acid, still more accurate results might be obtained.

The only methods for estimating copper that were experimented on were the well-known plan of precipitating the metal as an oxide by means of a solution of caustic potash or soda, washing well with boiling water, igniting, and weighing; and the plan of igniting either the sulphide or the sulphocyanide with sulphur in a stream of hydrogen gas. The accuracy of the first method is so well established that it is not necessary to give details of experiments. The latter methods also give exceedingly accurate and constant results.

For estimating the amount of arsenic in ores, from the above experiments, I should imagine the neatest, simplest, and most accurate mode of procedure to be to heat the finely-divided sample, in a gentle stream of chlorine gas, to a temperature of about 200° C., and to collect the escaping arsenic-chloride in chlorine-water. If free from antimony, the liquid might be well boiled, to expel free chlorine, and the arsenic precipitated with sulphuretted hydrogen, and weighed as As_2S_5; or it might, perhaps, be better estimated by some volumetric method.

In cases where the arsenic is obtained in the form of $AsO_4,Mg,NH_4,6H_2O$ (as in separations of the metal from antimony or copper), the most accurate plan would be to dissolve the precipitate in hydrochloric acid, and precipitate the arsenic as As_2S_5. When the amount of arsenic is small, it might be weighed as the double arseniate. The sample should not, however, be dried at a higher temperature than that of an ordinary water-bath—namely, about 95° C. Perfectly accurate results could, no doubt, be obtained by drying the precipitate over sulphuric acid, when it retains its 6 equivs. of water. The only objection is that it would take days for a filter containing a precipitate to be properly dried by this means.

Runcorn, March 8th, 1870.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 126).

Lesson IV.

Structure of Wood.

With the point of a sharp knife, split, *not cut*, thin splinters from a lucifer match or piece of deal. Suitable fragments may often be found at the bottom of a box of matches. Examine with O1; illuminate with Parabolic Lieberkuhn or [*condensing lens*], using Disc-Holder or [*stage forceps*] as a support. The splinter will exhibit a fibrous structure, varying in character according to the direction of the split. The simplest structure in this specimen is the cellular tissue crossing the woody fibres; these lines of cells run from the centre of the stem to its circumference, among the fibres and ducts, keeping up a communication between the centre and the growing portion between the wood and the bark, known as the *cambium layer*. The sides of the woody fibres are, in deal, covered with rows of dots, which are characteristic of the *Coniferæ*, although they are found in the woody tissues of some few other trees. To see these well, a higher power will be required, O4, and Parabolic, or [*spherical lieberkuhn*], and to secure the most favourable position for observation the disc-holder will be found convenient.

To thoroughly investigate the structure of wood, three sections are necessary, one across the stem and two in a longitudinal direction. For the purpose of study, where large and fine specimens are not required, the use of a section machine may be dispensed with, as small sections in any direction may easily be cut with a sharp knife or razor.

The transverse section shows the general arrangement of the tissues composing the stem, consisting of a concentric arrangement of fibres and vessels, of which the cut ends only are seen in this section; the concentric rings represent periods of growth, and usually, but not always, correspond with the number of years the stem has been forming; the *medullary* rays are seen running from the pith in the centre to the circumference—they are developed to an enormous extent in the Clematis, where their grouping in masses gives a marked character to the transverse section.

The other two sections are longitudinal, and are cut, one parallel to the medullary ray and the other across it. The first, or *radial section*, exhibits the sides of the medullary rays; the second, *tangential section*, their cut ends; these are very conspicuous in mahogany.

The structure of the stem of endogenous plants differs considerably from that of exogens, just described; in these, there is no very marked distinction between wood and bark—the rings of annual growth and the medullary rays are wanting, so that a single longitudinal section only is required, instead of the two needed to demonstrate the structure of an exogen (a section of cane will supply a good example). For the histology of plants, see Bentley's "Manual of Botany," Book I. There are many very accurate figures of vegetable tissues throughout Hassall. The knowledge of the minute structure of plants is of the greatest use to the analytical microscopist, as it is by this means alone that mixtures of vegetable powders can be detected. Full details are given in Hassall.

Sections of woods, such as ebony, box, and some others, which are too hard to be cut in the usual manner, may be obtained by grinding, as in the case of bone; this process must also be adopted with cellular tissue, when hardened by deposits of sclerogen, as cherry and plum stones, ivory nuts, cocoa-nut shell, and many other hard substances. Soft substances, as leaves, may be cut by being pressed between two pieces of cork, which are sliced with it. Cellular tissue like that of the common rush, which yields so much to the knife that it is pressed aside instead of being cut, should be saturated with melted wax before attempting to make a section; this can be removed from the thin slices with benzol.

(To be continued.)

THE "WEAPON-SALVE" OF PARACELSUS.

By G. F. RODWELL, F.C.S.

Among the more curious of the magical remedies of the sixteenth and seventeenth centuries was a certain ointment, invented by Paracelsus, which, he asserted, would cure all wounds resulting from violence by being applied to the weapon which had caused the wound (or its facsimile), under certain precise and stringent conditions. The directions which are given for the preparation of this unguent vary slightly, according to different authors. It was to be compounded of moss from the skull of an unburied man, gathered under certain planetary conditions, of oil, "mummy," and human blood; while some recommended the addition of the "dryed brain of a wilde bore." The most minute directions were given for applying the unguent to the weapon; and a slight carelessness could as easily cause the death of the patient as his cure: thus it was said, "Beware that the weapon fall not downe, nor the winde blow upon it in a cold place, for it will force the patient to madness." Many writers wrote strongly in favour of this cure; among them, Crollius, Baptista Porta, Cardanus, Burgravius, and Coclinius. Lord Bacon alludes to it in his "Sylva Sylvarum" (cent. 10, par. 998), and adds, "though myself, as yet, am not fully inclined to believe it." Robert Fludd, a physician, and a contemporary of Bacon, was one of its staunch supporters.

Now, a certain William Foster, "M.A., and Parson of Hedgeley, in the County of Buckingham," who appears to have been fond of controversy, and dissatisfied with his position in the Church, was particularly bitter against this cure, which he verily believed to be the work of the devil. Full of this idea, he published a brochure of fifty-six pages, in 1631, entitled "Hoplocrisma Spongus; or a Sponge to wipe away the Weapon-Salve. A treatise wherein is proved that the cure late taken up amongst us, by applying the salve to the weapon, is magicall and unlawful." In the preface, Foster, in vindication of the violent attack which he made upon the advocates of this cure, says—"I dare call sin, sin in whomsoever. If Jesabell be painted, with Jehu I will not have peace with her to commend her, though a queene. If Herod be incestuous, with the Baptist I'll not sooth him, though a king. If Simon Magus be a socerer, I feare not his divell; with S. Peter, I'll rouze him, though a witch. Shall anyone, for my boldnesse, think to sit upon my skirts? Let these knowe I esteeme myself *infra invidiam*. I cannot have lesse in the Church, unlesse nothing. And, if they shall endeavour to keep me still low, let them knowe I looke for no good from them that envie my endeavours to do good." Against Fludd, as one of the most recent advocates of the cure, Foster is specially virulent; indeed, the brochure is principally directed at him. At first, Fludd took no notice of the attack, deeming Foster, as he tells us, not worthy of notice; but, finding

one morning that Foster had caused a title-page of the "Hoplocrisma Spongus" to be nailed to each of his door-posts, he was so incensed thereby that he forthwith brought out a brochure of 212 pages in reply. It is entitled—"The Squeezing of Parson Foster's Sponge, ordained by him for the wiping away of the Weapon-Salve. Wherein the sponge-bearer's immodest carriage and behaviour towards his brethren is detected; the bitter flames of his slanderous reports are, by the sharpe vineger of truth, corrected and quite extinguished; and, lastly, the vertuous validity of the sponge in wiping away of the weapon-salve is crushed out, and thus abolished." On the title-page, Fludd introduces a verse from the 92nd Psalm concerning the fall of the wicked man, and also the somewhat pointed remark—"Opera Dei, vir brutus et stultus, non intelligit." It is to be confessed, however, that he was a good deal provoked. The manner in which the controversy was continued is somewhat amusing, when we remember the subject of it. Foster, after mentioning several men who had advocated the weapon-salve, and indirectly including Fludd amongst them, says—"I wonder at nothing more than that Beelzebub was not in the number." To which Fludd replies—"A singular diabolical conceit. . . . . Marry, I will tell him why:—If it had been true that the use of the weapon-salve is witchcraft, and the users thereof witches and conjurers (as he boldly saith), how, I pray you, should Beelzebub be missing from our company? . . . And this is the reason that Mr. Foster and his like have failed to find Beelzebub or the Devil in this number, forasmuch as he is nearer to them than they are aware of."

After vindicating himself, and disavowing all connection with magic and necromancy, Fludd attacks certain of Foster's statements in regard to other matters. "I will proceed now," he says, "to the greatest assault, wherein his sponge rubbeth very hard against my text, but prevaileth no more than they which go about to wash away the colour of a black-moore." He then enters into an elaborate statement to prove that "devils have aëry bodies allotted to them in their creation," which Foster had denied. And thus is the foolish controversy continued to the end. The amount of erudition brought to bear upon it is surprising, and worthy of a better theme. An assertion is rarely made on either side without a quotation to back it up, Foster preferring the Fathers of the Church (notably SS. Augustine and Jerome), while Fludd goes back to the ancient Greeks, and to Hermes Trisinegistus. They both quote the Scriptures profusely, Foster because he is a clergyman, Fludd because he knows that arguments drawn from that source will most prevail with a Churchman.

We do not hear much more of the weapon-salve. After all, it is scarcely more absurd than some of the beliefs which prevail in the present day in remote country districts—such, for instance, as the cure of warts by rubbing them with a piece of stolen meat. The belief in cures of this nature was rife in the seventeenth century, Bacon asserts many of them. We must remember that the belief in witches and demons, spells, conjurations, philtres, and raisings of the devil, was as firm then amongst all classes of Society as it is now in many a lone hamlet in Cornwall, and many a green village of Galway or of Wales. Of necessity, superstition lingers longest in those places which are most removed from centres of thought and civilisation. There is a conservative attitude of idea about people who are much shut out from the external world. We know a village not two hundred miles from London (which there is no reason to believe differs from other villages distant from large towns) in which there are many Middle-Age superstitions; there is a witch, moreover, who possesses the power of the evil-eye, and those who offend her are sure to suffer, sooner or later, some dire calamity; we have not yet heard of her raising a familiar demon. Now, all this goes on in a village by no means debarred from the progress of civilisation; there is a boys' school with a certificated master, a girls' school with a certificated mistress, a night-school, a Sunday-school, penny-readings, and occasional concerts, not to speak of a really good village-library. If, then, in this nineteenth century, all manner of rank superstitions are among us (and we have most of us some pet superstition or other), we can scarcely cry shame on the advocates of the weapon-salve two centuries and a half ago. As for Parson Foster, of Hedgeley, he was certainly a man born out of due time.

QUICK WET ASSAY OF GALENA AND OTHER COMPOUNDS OF LEAD.*

By FRANK H. STORER,
Professor of Chemistry in the Massachusetts Institute of Technology.

WHEN in contact with metallic zinc, galena is readily decomposed by acids. Even oxalic, acetic, and dilute sulphuric acids are capable, when hot, of decomposing galena,—metallic lead being deposited and sulphuretted hydrogen gas set free,—while with chlorhydric acid the decomposition is peculiarly rapid and complete.

Galena is easily decomposed, also, even in the cold by dilute nitric acid in presence of zinc; but the reaction differs in this case from that just described—not metallic lead but free sulphur is deposited, while nitrate of lead goes into solution.

The reaction with zinc and chlorhydric acid may be employed with advantage for assaying galena, particularly the common American variety, which contains no other heavy metal besides lead. The details of the process are as follows:—Weigh out 2 or 3 grms., or more, of the finely powdered galena. Place the powder in a tall beaker, together with a smooth lump of pure metallic zinc. Pour upon the mixed mineral and metal 100 or 150 c.c. of dilute chlorhydric acid which has been previously warmed to 40° or 50° C.; cover the beaker with a watch glass or broad funnel, and put it in a moderately warm place.

Chlorhydric acid, fit for the purpose, may be prepared by diluting 1 volume of the ordinary commercial acid with 4 volumes of water. For the quantity of galena above indicated, the lumps of zinc should be about an inch in diameter by a quarter of an inch thick; they may be readily obtained by dropping melted zinc upon a smooth surface of wood or metal.

The zinc and acid should be allowed to act upon the mineral during fifteen or twenty minutes in order to ensure complete decomposition. Any particles of galena which may be thrown up against the cover or sides of the beaker should, of course, be washed back into the liquid. It is well, moreover, to stir the mixture from time to time with a glass rod.

When all the galena has been decomposed, as may be determined by the facts that the liquid has become clear, and that no more sulphuretted hydrogen is evolved, decant the liquid from the beaker into a tolerably large filter of smooth paper, in which a small piece of metallic zinc has been placed. Wash the lead and zinc in the beaker as quickly as possible with hot water, by decantation, until the liquid from the filter ceases to give an acid reaction with litmus paper; then transfer the lead from the beaker to a weighed porcelain crucible. In order to remove any portions of lead which adhere to the lump of zinc, the latter may be rubbed gently with a glass rod, and afterwards with the finger or a piece of caoutchouc, if need be. Wash out the filter into an evaporating dish, remove the fragment of zinc, and add the particles of lead thus collected to the contents of the crucible. Finally, dry the lead at a moderate heat in a current of ordinary illuminating gas, and weigh.

The lead may be conveniently dried by placing the

* Communicated by the Author.

crucible which contains it in a small cylindrical air-battery of Rammelsberg's pattern, provided with inlet and outlet tubes of glass, reaching almost to the bottom of the bath.

When the process is conducted as above described, the lead undergoes no oxidation; hence there is no occasion for igniting the precipitate in a reducing gas. The precipitate needs only to be dried out of contact with the air.

If desirable, the sulphur in the galena could be determined at the same time as the lead, by arresting the sulphuretted hydrogen in the ordinary way.

If the mineral to the analysed is contaminated with a siliceous or other insoluble gangue, the metallic lead may be dissolved in dilute nitric acid, after weighing, and the insoluble contamination collected and weighed by itself. In the case of galenas which contain silver, antimony, copper, or other metals, precipitable by zinc, the proportion of each metal must be determined by assay or analysis in the usual way after the total weight of the precipitated metals has been taken.

Besides galena, almost any of the ordinary lead compounds may evidently be assayed by the method above described. I find, for example, that metallic lead may be precipitated quickly and completely from the sulphate, chromate, nitrate, oxide, and carbonate—and with peculiar ease from the chloride—by means of zinc and chlorhydric acid. The method would furnish an easy qualitative test for the detection of barytes in white lead. When applied to the analysis of nitrate of lead, it would probably be best to decompose the nitrate by means of a solution of chloride of sodium before adding the zinc and chlorhydric acid.

In all these cases the decomposition of the lead salt by the zinc is so complete, that no trace of colouration is produced when sulphuretted hydrogen is added to the liquid decanted from the metallic lead.

The following determinations of lead in a sample of pure galena from Galena, Illinois, were made in the manner above described by my assistant, Mr. A. H. Pearson —

	Grammes of galena taken.	Grammes of lead found.	Per cent of lead found.	Theory.
No. 1.	1·4847	1·2908	86·93	86·62
,, 2.	0·5902	0·5120	86·75	
,, 3.	3·6320	3·1568	86·91	

Attempts to determine sulphur and lead in the same portion of galena, by means of the reaction of zinc and dilute nitric acid, above described, gave no satisfactory results. The free sulphur obtained by treating galena with zinc and ordinary nitric acid, diluted with 3, 4 and 5 volumes of water, always retained a small quantity of lead, while a certain amount of sulphuric acid was found in the clear liquid. It is, in short, well nigh, or quite, impossible to avoid the secondary reactions between zinc and nitrate of lead, and between sulphur and nitric acid which set in as soon as, or just before, the last traces of the galena have been decomposed.

Boston, Feb., 1870.

ON THE ESTIMATION OF AMMONIA IN ATMOSPHERIC AIR.*

By HORACE T. BROWN.

In the attempts that have been hitherto made to estimate the ammonia present in atmospheric air, the results arrived at by the various experimenters have differed so widely that it is still a matter of uncertainty what the quantity really is. That it is a very small amount all agree, but the extreme results on record vary as much as from 13·5 to 0·01 part of carbonate of ammonium per 100,000 of air. It may, therefore, not be without interest to give an account of a simple method affording very concordant and, I believe, accurate results; at the same time being easy of performance and requiring but little time for an experiment.

The apparatus used consists of two glass tubes, each of about 1 metre in length and twelve m.m. bore. These are connected air-tight by means of a smaller glass tube, and inclined at an angle of 5° or 6° with the horizon. Into each of the larger tubes are introduced 100 c.c. of a mixture of perfectly pure water and two drops of dilute sulphuric acid (sp. gr. 1·18). Through this acidulated water a measured quantity of the air under examination is slowly drawn, in small bubbles, by means of an aspirator.

No porous substance must be used to filter the air, for reasons to be stated hereafter. The air is conducted into the absorption liquid through a small piece of quill tubing drawn out to a small aperture at the end, immersed. This tube must be kept quite dry throughout the experiment. Great care must be taken to cleanse perfectly every part of the apparatus with water free from ammonia, and the caoutchouc plugs, or corks, used must be boiled for a short time in a dilute solution of caustic soda.

The stream of air is so regulated as to allow about 1 litre to pass through the apparatus in an hour.

By directing the point of the delivery-tube laterally, each bubble has imparted to it on rising an oscillatory movement, which facilitates complete absorption of the ammonia.

When from 10 to 20 litres of air have passed, the liquid is emptied from the tubes into upright glass cylinders, an excess of a perfectly pure solution of potash added, and then 3 c.c. of a Nessler solution. The standard of comparison is made in the ordinary way, only using acidulated in place of pure water, and neutralising with potash after adding the standard solution of ammonium salt. Beyond somewhat retarding the point of maximum colouration, a little potassium sulphate does not interfere with the delicacy of Nessler's reaction.

If the experiment has been conducted with proper care, at least four-fifths of the total ammonia ought to be found in the first tube. Four or five litres of air are generally quite sufficient to give a decided reaction, but it is better to use not less than 10 litres, as before mentioned.*

Very many experiments have been made by this method, both on air from the town of Burton-on-Trent, and that of the adjoining country. The air from the town, as might be expected, varies somewhat in composition; much more so than that taken from the open country, as may be seen from the following tables, in which are given some of the numerous results obtained.

The ammonia is calculated in every case as carbonate [$(NH_4)_2CO_3$]; for although nitric acid is sometimes found in air, yet its presence must be looked upon as accidental.

In the immediate vicinity of towns some of the ammonia must also be in the form of sulphate, sulphite, or ammonium chloride.

(1). *Air taken from town.* (Taken at a height of 2 metres from ground.)

Date of Experiment.	$(NH_4)_2CO_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(NH_4)_2CO_3$ in parts by weight per 100,000 of air.
1869. Sept. 30	1·12940	0·8732
Oct. 4	0·62117	0·4801
,, 6	0·52510	0·4059
,, 8	0·62117	0·4801
Nov. 26	1·07290	0·8293
,, 28	1·10000	0·8503

* A paper read before the Royal Society, March 17, 1870.

* When the air to be examined is highly charged with ammonia, as that from stables, &c., a perfectly dry bottle of 3 or 4 litres capacity should be carefully filled with a pair of bellows, 100 c.c. of acidulated water introduced, and, after closing securely, the whole well agitated at intervals for three or four hours. The liquid is then poured out, and the NH_3 estimated by the Nessler solution as usual.

(2). *Air from country.* (Taken at a height of 2 metres.)

Date of Experiment.	$(NH_4)_2CO_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(NH_4)_2CO_3$ in parts per 100,000 of air.
1869. Dec. 6	0·7620	0·5890
,, 8	0·7826	0·6085
,, 9	0·6601	0·5102
,, 11	0·6635	0·5121
1870. Feb. 12	0·7639	0·5904

The direction of the wind does not seem to have any influence on the ammonia found; immediately after heavy rain, however, the quantity falls somewhat below the average, but the air is again restored to its normal condition after a lapse of two or three hours.

Attempts were made to make the method more delicate still by absorbing the ammonia in pure water and then distilling, but the nitrogenous organic matter suspended in the air was found to interfere with the results.

When the air is passed through cotton-wool before entering the absorption-tubes, it is found to be entirely deprived of its ammonia by the filter. This is also the case with air artificially charged with ammonia *to a large extent*. This absorption is not due to the presence of hygroscopic moisture, since cotton-wool, when absolutely dry, is capable of taking up 115 *times its own bulk* of dry ammonia (confined over mercury) at 10·5° C. and 755·7 millims. barom.; the gas being again slowly evolved when the wool is left in contact with the air at 100° C.

All other porous substances that were tried for filtering agents were found to possess this property more or less; even freshly ignited pumice-stone is not entirely without absorptive effect upon the gas.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

March 17th, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

THE following gentlemen were elected fellows:—D. Brown, A. Muirhead, T. L. Patterson, D. Penny, S. T. Smith.

The first paper read was "*On Artificial Alizarine*," by W. H. PERKIN, F.R.S.

Alizarine was first obtained from madder in a crystalline state by Robiquet and Colin. Their method of preparation (viz., sublimation) rendered it, however, a matter of doubt whether alizarine existed as such in the madder, or was a product of decomposition of some other body. Dr. Schunk, having succeeded in obtaining alizarine-crystals without taking recourse to sublimation, proved the first view. He gave it the formula $C_{14}H_{10}O_4$; whilst Strecker believed it to be $C_{10}H_6O_3$, relating it to Laurent's chloroxynaphthalic acid, since both these substances yield phthalic acid on treatment with hydric nitrate; in fact, chloroxynaphthalic acid was regarded as chlorinated alizarine—

$\underbrace{C_{10}H_6O_3}$. Alizarine, or oxynaphthalic acid.

$\underbrace{C_{10}H_5ClO_3}$. Chlorinated alizarine, or chloroxynaphthalic acid.

About five years since, Martius and Griess, when investigating the amido-derivatives of naphthol, obtained a colouring-matter possessing Strecker's formula; yet it was not alizarine, but a body isomeric with it. Some time after the discovery of this supposed isomer of alizarine, Graebe commenced his researches on quinone. This substance, obtained, as early as 1838, by Woskressensky as a product of the oxidation of quinic acid, was regarded by Kekulé as containing two molecules of carbonyl—$CO=C_4H_4=CO$. But Graebe, induced by the results he had gained in his investigations of the quinone compounds, viewed it as a substitution-product of benzol, two of whose hydrogen-atoms are replaced by the group $[O-O]''$, in which half of the combining-values of oxygen saturate each other—

$\underbrace{C_6H_6}$. Benzol.

$\underbrace{C_6H_4(O_2)''}$. Quinone.

The best-known derivative of quinone is chloranil, or perchloroquinone, which is obtained by heating phenol with potassic chlorate and hydric chloride. When this body, $C_6Cl_4(O_2)''$, is heated with alkalies, potassic chloranilate, or dichloroquinonate, is formed. According to this reaction, Graebe regarded Laurent's chloride of chloroxynaphthyl as the dichlorinated quinone of naphthaline—

$\underbrace{C_{10}H_8}$. Naphthaline.

$\underbrace{C_{10}H_4Cl_2(O_2)''}$. Chloride of chloroxynaphthyl, or dichlornaphthoquinone.

When this naphthaline derivative is heated with alkalies, it behaves like chloranil; but, whilst, in the latter compound, two atoms of chlorine are removed, only one chlorine-atom is displaced in the case of the naphthaline derivative—

$$\underbrace{C_{10}H_4Cl_2(O_2)''}_{\text{Dichlornaphthoquinone.}} + 2KOH = \underbrace{C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\KO\end{matrix}\right.}_{\text{Potassic chloroxynaphthalate.}} + KCl + H_2O.$$

$$C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\KO\end{matrix}\right. + HCl = \underbrace{C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\HO\end{matrix}\right.}_{\text{Chloroxynaphthalic acid.}} + KCl.$$

Chlorinated quinones of toluol were obtained by Graebe and Burgmann, by heating cresylic acid with potassic chlorate and hydric chloride—

$C_6\left\{\begin{matrix}CH_3\\(O_2)''\\Cl_3\end{matrix}\right.$ Trichlortoluquinone.

$C_6\left\{\begin{matrix}CH_3\\(O_2)''\\Cl_2\\H\end{matrix}\right.$ Dichlorotoluquinone.

After it had been shown that chloroxynaphthalic acid was a quinone-acid, Graebe and Liebermann thought it probable that alizarine belonged to the quinone series. To gain some information about the hydrocarbon to which alizarine is related, they heated a specimen of the natural colouring-matter with powdered zinc, according to Baeyer's method of reducing aromatic compounds; and they obtained a substance of the composition $C_{14}H_{10}$. This hydrocarbon formed, with picric acid, a red compound, and, in fact, possessed all the properties of anthracene as obtained from coal-tar. This discovery led Graebe and Liebermann to assume alizarine to be the quinone-acid of anthracene—

$\underbrace{C_{14}H_{10}}$. Anthracene.

$\underbrace{C_{14}H_8(O_2)''}$. Anthraquinone.

$\underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\HO\\HO\end{matrix}\right.}$. Anthraquinonic acid or alizarine.

Having obtained anthracene from alizarine, it now remained to produce alizarine from anthracene. Many years ago Laurent had obtained an oxygenated derivative of anthracene of the composition $C_{14}H_8O_2$. Graebe and Liebermann at once recognised this as the quinone of anthracene, and now it remained for them only to transform this anthraquinone into the acid by replacing two atoms of hydrogen by two of hydroxyl. For this purpose they heated anthraquinone with bromine, whereby dibromanthraquinone was obtained—

$$C_{14}H_8(O_2)'' + 4Br = C_{14}H_6\left\{\begin{matrix}(O_2)''\\Br_2\end{matrix}\right. + 2BrH.$$

On treating this with potassic hydrate at a temperature of about 180° C., the potassium salt of alizarine was ob-

tained, from which the alizarine was liberated by hydric chloride—

$$\underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\Br_2\end{matrix}\right.}_{\text{Dibromanthraquinone.}} + 4KOH = \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\(KO)_2\end{matrix}\right.}_{\text{Potassic alizarate.}} + 2KBr + 2H_2O.$$

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\(KO)_2\end{matrix}\right. + 2HCl = \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\(HO)_2\end{matrix}\right.}_{\text{Alizarine.}} + 2KCl.$$

By thus producing alizarine from anthracene, Graebe and Liebermann have given the first instance of the artificial formation of a vegetable colouring matter.

But to turn this beautiful discovery to practical account, to render alizarine from anthracene a substitute for madder, it was necessary to replace the bromine required in the process by some cheaper reagent. It is known that hydric sulphate forms with many organic bodies compounds called sulpho-acids. According to the experiments of Wurtz and of Kekulé these compounds are acid sulphites.

$$\underbrace{C_6H_6SO_3}_{\text{Sulpho-benzolic acid.}} = \underbrace{C_6H_5.HSO_3}_{\text{Phenyl-sulphurous acid.}}$$

$$\underbrace{C_{10}H_8(SO_3)_2}_{\text{Disulpho-naphthalic acid.}} = \underbrace{C_{10}H_6\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right.}_{\text{Naphthaline disulphurous acid.}}$$

for, when heating sulpho-benzolic acid with potash they obtained a carbolate, and a sulphite—

$$C_6H_5.HSO_3 + 3KOH = C_6H_5KO + K_2SO_3 + 2H_2O.$$

Disulpho-naphthalic acid yields, by similar treatment, a naphthalenate and a sulphite—

$$C_{10}H_6\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right. + 6KOH =$$

$$= \underbrace{C_{10}H_6\left\{\begin{matrix}KO\\KO\end{matrix}\right.}_{\text{Potassic naphthalate.}} + 2K_2SO_3 + 4H_2O.$$

This potassic naphthalate can, by addition of an acid, be transformed into hydric naphthalate,

$$C_{10}H_6\left\{\begin{matrix}HO\\HO\end{matrix}\right.$$

which body stands to naphthaline in the same relation as alizarine to anthraquinone.

It appeared therefore probable that if a disulpho-acid of anthraquinone could be found, the formation of alizarine by a similar process may be rendered possible.

The formation of this sulpho-acid seemed, at first, not very probable, on account of the remarkable stability of anthraquinone, but on strongly heating it with hydric sulphate a sulpho-acid was at last obtained, which, on analysis, was found to be the desired disulphoanthraquinonic acid—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\HSO_3\\HSO_3\end{matrix}\right.$$

This compound, heated with potassic hydrate to about 180° yields sulphite and alizarate of potash—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\HSO_3\\HSO_3\end{matrix}\right. + 6KHO =$$

$$= \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\KO\\KO\end{matrix}\right.}_{\text{Potassic alizarate.}} + 2K_2SO_3 + 4H_2O.$$

from which potash salt the alizarine is thrown down by acids, just as brightly coloured and as pure as the alizarine from dibromanthraquinone.

It is, however, to be remarked that alizarine is not the primary product of the reaction of potash on the sulpho-acid, an intermediate body being first produced, which may be called sulphoxanthraquinonic acid, and the formation of which may be thus expressed:—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\HSO_3\\HSO_3\end{matrix}\right. + 4KOH =$$

$$= \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\KO\\HSO_3\end{matrix}\right.}_{\text{Potassic sulphoxanthraquinonic acid.}} + K_2SO_3 + 3H_2O.$$

This intermediate body is crystalline, of a yellow or orange colour, easily soluble in water, produces, with caustic alkalies, violet or blue solutions, and when heated with potassic hydrate yields alizarine and sulphurous acid.

The process just described may be modified by first forming a disulpho-acid of anthracene, and then converting this by means of oxidising agents into the disulpho-anthraquinonic acid.

In the conversion of disulphoanthraquinonic acid into alizarine by the action of potassic hydrate, a peculiar reverse action takes place to some extent, both anthraquinone and anthracene being formed.

Artificial alizarines entirely identical with the colouring matter obtained from the madder root. Both of the products crystallise in needles, which are usually curved, especially when small. They dissolve in caustic alkalies, forming violet solutions of the same tint. When applied to mordanted fabrics they produce exactly the same colours, bearing the treatment with soap equally. They also possess precisely the same tinctorial value. The colours produced on fabrics by the artificial alizarine are as fast against light as those of madder. Cupric acetate produces in their alcoholic solutions a purple colouration. Their alkaline solutions show identical absorption bands in the spectrum. Both yield phthalic acid when treated with hydric nitrate.

It may be observed that a solution of sulphoxanthraquinonic acid in alcoholic potash has a very similar spectrum as an analogous alizarinic solution; but the spectra of the respective aqueous solutions are quite different.

As a substitute for madder artificial alizarine has been objected to, on the ground that pure alizarine alone will not produce the madder colours, other colouring matters being required. But Schunck says that, after a long course of experiments, he has been led to the conclusion, that the final result of dyeing with madder is simply the combination of alizarine with the various mordants employed, and he recommends extraction from madder prints as the easiest method of preparing pure alizarine on a small scale. Mr. Perkin, on experimenting in this direction, could find nothing but alizarine on finished madder print. There is a second colouring matter in the madder root, the purpurine, but this cannot be found in the colour of the prints; if a mere trace of it were present it could easily be detected by its characteristic spectrum. It cannot be affirmed that purpurine never exists on prints dyed with madder or garancin, but it is certain that the higher the class of print, and, consequently, the more brilliant the colours, the purer is the alizarine in combination with the mordants.

Artificial alizarine as sent to the dyer and printer is not exactly pure alizarine, and generally produces, with alumina mordants, a somewhat redder shade than madder. This is due to some impurities, whose nature is, as yet, not known. Schunck has, however, already succeeded in obtaining a yellow crystalline body from the residues; but this yellow substance does not appear to have any affinity for mordants, and therefore cannot be injurious.

A good deal has been said about the supply of anthracene. It must be remembered, however, that tar distillers have had as yet but little experience in separating

this substance. Mr. Perkin's investigations on this matter have led him to believe that coal-tar contains considerable quantities of this hydrocarbon. No doubt the kind of coal used as well as the temperature employed in the gas works, influences the quality of the tar as a source of anthracene, but upon these points no definite information has yet been obtained.

Mr. Perkin illustrated his highly interesting lecture by exhibiting samples of fabrics dyed and printed with artificial alizarine, and also by projecting the spectra of some alizarine solutions on a screen.

The following paper was "*On the Combinations of Carbonic Acid with Ammonia and Water*," by Dr. Divers, the reading of which, however, was, on account of the advanced hour, postponed for the next meeting, when, besides this, the following papers will be read: "Deep Sea Water," by John Hunter, and "Refraction Equivalents of Aromatic Hydrocarbons," by Dr. Gladstone.

CORRESPONDENCE.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—With your correspondent Mr. Gibbins I saw the objections to Dr. Hofmann's improvement in the manufacture of sulphuric acid. Still the advantages to be derived from it, especially in the present condition of the nitrate market, are so large that I at once decided on giving it a fair trial, and am now arranging my vitriol chamber so as to obviate one of the difficulties named by your correspondent, and which, if not provided for, would probably be fatal.

The description will, probably, explain my object:—I have, say, six vitriol chambers at work, nearly all of large size; into No. 1 I work one set of furnaces and into No. 2 another set. The gases from No 1 and from No. 2 meet in No. 3; this and No. 4 I shall work up to 1·715 specific gravity.—Nos. 1 and 2 will work at 1·45; all the acid produced in No. 3 will be passed into No. 1 and all produced in No 4 into No. 2: the acid of 1·715 as it mixes with that of 1·45 will give up its nitric oxide, which thus at once becomes again available and the acid can then be run off for use from Nos. 1 and 2 in ordinary condition. The strong action having taken place in Nos. 3 and 4 I shall work 5 and 6 at a lower strength in order to insure condensation. I shall thus I hope reduce Dr. Hofmann's very valuable suggestion to a rather more practical shape, and if I can by even partial success save, say, a couple of tons of nitrate of soda per week, I shall gladly renew my chambers a year sooner than would otherwise be needful.—I am, &c.,

PETER SPENCE.

Pendleton Alum Works, Manchester, March 21, 1870.

ACTION OF IODINE ON HYPOSULPHITE.

To the Editor of the Chemical News.

SIR,—In a paper by C. R. A. Wright, published in the CHEMICAL NEWS (vol. xxi., p. 103), reference is made to a paper "On the Estimation of Manganese," published in the CHEMICAL NEWS (vol. xx., p. 302), in which the autohrs say:—"In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition," the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62·7 per cent of available peroxide in the manganese ore assayed, when tested immediately after the decomposition, and to over 63 per cent after standing twenty-four hours. "This was caused by the conversion of iodine into hydriodic acid."

In a note published in the CHEMICAL NEWS (vol. xxi p. 48), and which seems to have escaped Mr. Wright's notice, the following explanation of this is given:—

"These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid set free by hydrochloric acid distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 3 per cent of peroxide of manganese when titrated with hyposulphite.

Mr. Wright's experiments, though very interesting, do not in the least "account for the results obtained by Messrs. Sherer and Rumpf," since the conditions were not identical.—I am, &c.,

EDWARD SHERER.

4, St. Nicholas Buildings, Newcastle-on-Tyne, March 21st, 1870.

MISCELLANEOUS.

Science in the Nineteenth Century!—The following advertisement, taken from the pages of a contemporary, is too good a joke to be lost:—"BRITISH SCIENCE having been for some time suspected of owing much of its reputation to the indifference of the general public on philosophical subjects, the truth or accuracy of which it has had no special means of acquiring practical information, or has been more or less blinded by an overweening confidence in the supposed skill of paid officials or royal Professors, several gentlemen have made it their business, at a great cost of time and labour, to investigate the grounds on which the various Astronomical and Geographical Societies have based many of their principal theories. The *assumed* convexity or curvature of the earth's surface is found to be as gross a delusion as its supposed orbital and axial motion;—That it is nothing but a stationary plane of hill and dale and level, over the face of which the sun and moon and stars revolve; that Ptolemy and the ancient Greek philosophers were the only truthful and trustworthy authorities on matters of astronomical science, and that the later theories of Galileo and Sir Isaac Newton are directly contrary to Scripture, to reason, and to the positive evidence of our senses. Those who require or are disposed to accept further particulars, are requested to communicate with ——, enclosing Three Stamps, for pamphlets and postage; with lists of larger works on this subject. Literary and Philosophical Societies will do well to disabuse their minds of the impression that they can much longer resist and resent the growing demand for a thorough revision and re-construction of their antiquated and erroneous systems."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, March 14 1870.

The number contains the following original papers relating to chemistry and allied sciences:—

Photographical Observation of the Passage of Venus, and on an Apparatus of M. Laussedat.—M. Faye.—Owing to the general importance of this lengthy memoir, we quote the title here.

On the Nascent State.—H. Sainte-Claire Deville.—Continuation of a former paper on this subject, and, like the first instalment, unsuitable for any useful abstraction. There are added to this paper several tabulated forms containing the results obtained.

General Theory of Chemical Action.—E. J. Maumené.—A memoir on this subject was read at the meeting, but is not published.

Experiments on the Velocity of the Propagation of Sound in Water contained in an Iron Tube of 0·8 Metre (31·496 inches) Diameter.—F. André.—The author describes, minutely, the arrangements made for conducting his experiments, and states that, while the temperature of the water, which entirely filled the tube, was 20° at the top end of the tube and 13° at the lower, the temperature of the air being 18°, he found, as result of his experiments, that the velocity of the sound per second of time was 897·8 metres. Dr. Wertheim deduced, from his experiments with brass organ-pipes, that the velocity of propagation of sound in water was 1173 metres for the same space of time. MM. Colladon and Sturm, while experimenting on this subject on the Lake of Geneva, found the velocity 1435 metres for a second of time.

Mechanical Properties of Steel Containing Phosphorus.—L. Gruner.—The results arrived at by this author may be summarised as follows:—Phosphorus present in steel in a quantity of from 0·002 to 0·003 causes the metal to be rigid; it tends even to increase the elasticity and the resistance to breaking, but does not modify the hardness. Such steel, however, is wanting in real strength and toughness; it is brittle (*aigre*)—that is to say, does not withstand shocks. The general result is, therefore, that even very small quantities of phosphorus present in steel do not only not improve, but certainly deteriorate, its good qualities. Prof. Boussingault concurs in this view, and stated at the meeting that Dr. Salet, the chief assistant to Prof. Wurtz, has arranged an ingeniously-constructed apparatus to detect the smallest possible quantity of phosphorus in iron and steel, by means of the spectrum produced by the combustion of the hydrogen obtained by the action of chlorhydric acid on the metal.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 15, March 12, 1870.

This number contains an excellent paper—

Lecture on the Shape and Figure of our Globe.—C. Wolf.—The contents of this paper, although not belonging to the sciences usually treated of by us, deserves the attention of all who wish to read a clear and concise account of the highly-refined scientific methods brought to bear upon the determination of the shape of the globe we inhabit. The author forgets to mention that the first measurement of a portion of a meridian arc ever made was executed very early in the seventeenth century by the celebrated mathematician, Simon Stevin, the teacher of Prince Maurice of Orange, and the inventor of carriages moved by the force of the wind, aided by sails. To Dominico Cassini is due the honour of having first suggested triangulations.

We also learn from this paper that the well-known physicist, Dr. Lallemand, has been transferred from the University of Montpellier to that of Poitiers, to fill the chair left vacant by the death of Dr. Tronessard there.

March 19, 1870.

This number does not contain any papers relating to chemistry, but we quote the titles of two excellent lectures published here, viz.:—

On the Evolution of Scientific Medicine and its Present State—Dr. C. Bernard; and—

Man of the Tertiary Period in America, and the Theory of Multiple-Centres of Creation—M. Hamy.

Cosmos, March 12, 1870.

Modification of Fortin's Barometer.—A. Amagat.—Instead of the movable bottom to the mercury cup of these barometers, the author displaces the mercury of the reservoir, by means of an iron or glass cylinder, which is forced down into the fluid by the aid of a screw. By this arrangement, the movable bottom (a strong skin) to the mercury cup, or reservoir, is dispensed with.

Fresh Butchers' Meat from America to Europe.—Herrera Yobes.—This author proposes to have the hold of vessels lined with metal (what kind of metal is not stated); the bottom of the hold is next covered with either clean straw, saw-dust, or bran, or any other suitable non-conductor of heat. Upon these, the freshly-killed and cut-up meat is placed, and on the top thereof a layer of ice, and on the top of that, again, straw or any of the other substances just named, and next, again, meat and ice, and so on; and after the hold has been thus filled, it is hermetically closed and suitably protected from the effects of hot weather during the journey from Montevideo to Europe.

Consumption of Albumen for Industrial Purposes.—It is a well-known fact that certain industries consume a very large quantity of albumen in some shape or other; sugar refiners, tawers, glove leather makers employ albumen in more or less pure state—in some instances the yolk of eggs only; but the calico-printers are the largest consumers, and this consumption is steadily on the increase. The printing works of the Alsace alone consume annually more than 150,000 kilos. of dried albumen, representing rather more than 37,000,000 of eggs, or the production of 250,000 hens; add to this the consumption of the printing works of other parts of France and of other countries, and there is very little doubt that annually some 150,000,000 eggs are used for that purpose alone.

March 19, 1870.

Amelioration of Wines by Electricity.—Dr. Scoutetten.—As a very tangible proof of the gain obtained by the immediate conversion of young wines into drinkable beverages by means of electricity, the author states that, considering that the annual production of wine of France amounts to from 60 to 70 millions of hectolitres (each equal to rather more than 22 gals.) and that at least 10 francs per hectolitre is lost by vapourisation during the time of the maturing of the wine while in casks, this represents a number of from 600 to 700 millions of francs gained by rendering wine fit for immediate consumption by the author's electric process. We may, not inaptly apply here—"Si non e vero e bene trovato."

Meteorite Observed at Alicante, Spain.—C. Miallejde.—The author states that, just about sunset on the 2nd inst., he observed, while walking on the pier (the town is situated on the Mediterranean), a meteorite, much akin in size, colour, and shape to, but far larger than, the planet Jupiter, moving with great speed from east to west.

Artificial Butter.—Dr. Mège.—When the stearic acid employed for making the so-called stearine candles, is strongly pressed (as is always done in its manufacture, to get rid of the oleic acid), an oily substance is obtained which, according to this author, is identical in composition with butter, but fluid. The author submits this material to several processes of infusion, decolouration, and beating (a kind of churning), and at last converts it, also, in physical appearance, into butter. The editor of this paper very properly adds that the Cossacks understand this matter far better, and with less ample machinery, since they, it is well known, are in the habit of converting oils readily into an unctuous substance by a simple process. The rationale, in both cases, is a partial saponification.

Journal für Praktische Chemie, No. 21, 1869.

This periodical contains the following original papers and memoirs:—

On Benzoic Acid and Gum Benzoin.—Julius Löwe.—The contents of this paper are the answers given to four queries, viz.:—(1) Does benzoic acid pre-exist in gum-benzoin ready-formed and in free state? (2) Is the benzoic acid present in the resin combined with a base? (3) Is benzoic acid a product of the oxidation of a part of the resin formed by the taking up of oxygen during the melting of the resin? (4) Is benzoic acid a product of a portion of the resin formed by the heat of the fusion of that substance? The author's experiments, detailed at great length, commenced with the finding of a reply to No. 3, and the result is a negative—*viz.*, that when the process of sublimation (as usually employed for obtaining benzoic acid from gum benzoin) is carried on in atmospheres of hydrogen or carbonic acid gas, the quantity and quality of the acid obtained are the same as when the process is carried on in contact with air. As regards the replies to Nos. 1, 2, and 4, a series of experiments made in various ways proved, undoubtedly, the pre-existence of ready-formed benzoic acid in the resin. The last portion of this paper is devoted to the very minutely-detailed description of the best practical method of the preparation of benzoic acid from the resin.

Composition of Soda and Lime Felspar.—G. Tschermak.—Since some doubt had arisen concerning the proper place to be assigned, in chemical mineralogy, to the minerals just named, the author made analyses of carefully-selected minerals, with the following results for 100 parts:—Silica, 48·94 and 49·40; alumina, 33·26 and 32·60; lime, 15·10 and 15·05; soda, 3·30 and and 2·95. The second numbers refer to and prove these felspars to be mixtures of 75 per cent of anorthite and 25 per cent of albite. The sp. gr. of the samples was, respectively, 2·729 and 2·723.

On the Haloid Compounds and their Derivatives Corresponding to Picric Acid and Dinitro-Phenol.—Conrad Clemm.—(Preliminary notice.) After briefly referring to Pisani's labours on this subject, the author says that the chloro-trinitro-benzol, obtained by causing pentachloride of phosphorus to act upon picric acid, is converted, by the action of ammonia and aniline, into trinitraniline and trinitro-diphenylamine, which latter substance yields, with sulphocyanide of potassium, a body, $C_{14}H_{11}N_8SO_{12}$. Chloro-dinitro-benzol has been prepared by the author from dinitro-phenol, as well as from chlorbenzol; both products are identical, and fuse about between 48° and 50°. By means of these compounds, it is possible readily to prepare from benzol, phenol derivatives. Dinitraniline has been prepared by the author by means of bi-nitrated bromobenzol, as, also, by means of chloro-dinitro-benzol; both products are identical, and their melting-point is 175°. Aniline and bromo-dinitro-benzol yield dinitro-diphenylamine, fusing at 153°. These researches will be continued, and the action of pure solid fused phenol upon sulphocyanide of potassium and upon sulphate of diazo-benzol will be investigated fully.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale No. 205, January, 1870.

This number does not contain any original papers relating to chemistry, but we meet here with a very extensive report, accompanied by several engravings, on—

Electric Clockwork and Machinery for Striking Hours and Quarters by means of Electric Action, as Executed by M. Pouraier and Reported on by O. Tresca.

Moniteur Scientifique, No. 318, March 15, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

Quantitative Estimation of Sugar.—Georges Ville.—This paper, too lengthy for any useful abstraction, is divided into the following sections:—Apparatus required, illustrated by woodcuts; reagents; estimation of total quantity of sugar; estimation of glucose; calculation of results; estimation of sugar in vegetable tissues; estimation of sugar in vegetable juices; tabulated form to assist in the calculations.

Determination of the Commercial Value of Bleaching-Powder and Manganese.—G. Tissandier.

Some Experiments with Salts of Chromium.—A Commaille.—This lengthy paper contains the following sections:—Nitric acid and bichromate of potassa; sulphuric acid and bichromate of potassa; chlorhydric acid and bichromate of potassa; iodic acid and bichromate of potassa; oxalic acid and bichromate of potassa; acetic acid and bichromate of potassa; tartaric acid and bichromate of potassa; citric acid and the same salt; tannic acid and the bichromate alluded to; and, lastly, benzoic acid and the same salt.

Chemical Dance: Instantaneous Apparition of Aniline Colours.—Under this title, a somewhat verbose, but, after all, elegantly-described curiosity, is related as follows:—Some few weeks ago, Madame A. W. Hofmann gave a grand entertainment and ball to the large number of her eminent husband's pupils. In the ball-room were placed, on the table, a large number of bouquets of flowers (artificial, of course), all snow-white, and close by, on the same table, a large number of pieces of beautifully-white silk ribbon; at the other end of the room a fountain was arranged, throwing, from narrow openings, jets of exquisitely-perfumed eau de Cologne. The bouquets were taken by the ladies, and the ribbons by the gentlemen; and, while waltzing together, and thus arriving at the end of the room where the fountain played, the ladies, holding their bouquets to be sprinkled over with the perfume, beheld the white flowers become suddenly beautifully red, violet, blue, yellow, and green-coloured, while the ribbons carried by the gentlemen assumed, under the same influence, similar colours. The secret of this trick is simply that the objects alluded to had been very gently dusted over with the dry powders of variously-prepared aniline colours, and, on becoming moistened by the eau de Cologne (alcohol), these powders became dissolved, and imparted colours to the objects.

Bulletin Mensuel de la Société Chimique de Paris, February, 1870.

From the *procès verbaux* of the meetings of this Society held in the month of January last, we learn, in the first place, that Ch. Friedel is the president of the Society for the present year, and MM. J. Bouis and E. Willm, secretaries. M. Terreil made a communication on the progress of his researches on the—

Treatment of Minerals by Saline Solutions.—(More especially alluding to the action of alkaline sulphides on native metallic sulphides.) Sulphide of antimony is readily dissolved; realgar (arsenical sulphide) is only incompletely dissolved; while the sulphides of tin and molybdenum (native) are not at all acted upon. Native sulphide of nickel and the white-coloured iron pyrites (mundic), also the magnetic pyrites, are slowly dissolved; but the yellow-coloured variety (coal brasses) is not acted upon. All minerals which contain sulphides of arsenic and antimony, as, for instance, ruby silver ore (grey antimony ore), are decomposed by alkaline sulphides; but mispickel, for instance, which is a metallic arsenide combined with sulphur, is not attacked by these solvents. Mispickel is an arsenical pyrites, containing iron, arsenic, and sulphur.

The President of the Society stated that he had been engaged with Dr. Ladenburg in researches on the—

Products of the Oxidation of Acetone.—Among these, mesoxalic acid has been found.

Dr. Wurtz spoke on the—

Synthesis of Organic Acids which can be obtained by Starting from Chlorinated Hydrocarbons by the Action of Chloroxycarbonic Ether in the Presence of Sodium.—Bromide of benzyle, treated with chloroxycarbonic ether and sodium amalgam, yields, with proper precautions, a complex crystallisable acid, $C_{14}H_{14}O_8$, dibenzyl-carboxylic acid, resulting from the action of one molecule of chloroxycarbonic ether upon two molecules of chloride of benzyl. The lime-salt of this acid yields, when submitted to destructive distillation, two hydrocarbons—viz., dibenzyle, $C_{14}H_{14}$; and stilben, $C_{14}H_{12}$.

The following papers were read:—

Chemical Equilibrium Existing between Carbon, Hydrogen, and Oxygen.—M. Berthelot.—This lengthy paper, which contains, also, the history of the earliest researches on the action of electricity upon gaseous compounds, is divided into the following sections:—Decomposition of carbonic acid; decomposition of aqueous vapour and steam; equilibrium between hydrogen, oxygen, and carbon; action of electric sparks upon mixtures of gases.

Spectra Exhibited by some Compound Bodies Present in Mixtures in the State of Equilibrium.—Dr. Berthelot and J. Richard.

Bromo-Toluen and Pseudo-Toluidine.—A. Rosenstiehl.—This paper is a very lengthy and sharply-critical reply to M. Wallach, who published an article under the above heading in the January number of this periodical.

Revue Hebdomadaire de Chimie, March 10, 1870.

Apparatus for the Evaporation of Beet-Root Juice, designated as *à Triple Effet*.—M. Schreiber.—A description of a very useful contrivance for the utilisation of waste steam for the purpose of evaporating the juice while circulating, so as to obviate, as much as possible, the formation of calcareous deposits from the juice against the sides of the evaporating pan.

Volumetrical Assay of the Iodine of Commerce.—A. Bobierre. An aqueous solution of iodide of potassium of known strength is made and kept invariable for a number of assays; this solution being destined to dissolve the iodine to be tested. Next, a solution (normal) of arsenite of soda is made, by dissolving, in a litre of water, 4·95 grms. of arsenious acid and 14·5 grms. of crystallised carbonate of soda (pure); this liquid completely decomposes any iodine containing liquid, the quantity of that haloid amounting to 12·688 grms. to the litre. A solution of bicarbonate of soda in cold water is made, rather concentrated, to be used as will be indicated presently. Take a small glass-stoppered bottle; pour into it 10 c.c. of the arsenite of soda solution and 5 c.c. of the bicarbonate of soda solution, and next 4 c.c. of benzol. Weigh off any quantity of a sample of pure iodine; dissolve it in a quantity of the above-mentioned solution of iodide of potassium, fill with this solution, which is, of course, brown-coloured, a bottle of 100 c.c. capacity. Shake the bottle containing the liquid, and pour, *guttatim*, into a graduated burette; the brown colour will disappear, the benzol becomes rose-coloured, and the aqueous liquid yellowish. It is clear that a second assay, made with the same quantity, by weight, as the first, but of the iodine to be tested, will give as result the richness of the sample in iodine, because the bulk of the solution required for the decomposition of the alkaline arsenite is inversely proportioned to the real quantity of iodine sought for.

Process of Sugar Manufacture.—M. Mueseler.—This process is based upon capillary action, but the description here given is too vague to give any adequate idea of its practical applicability.

Testing of Alcohol and Spirits for Amylic Alcohol.—Since the internal use of amylic alcohol, even in small quantity, is very deleterious, the means of rapidly testing for its presence in spirits and alcohol (either for pharmaceutical or scientific use) is of importance. The suspected alcohol is poured into a burette, mixed with its own bulk of rectified and pure ether, and also its own bulk of water, and the mixture gently shaken; the ether, on becoming separated from the rest of the fluid, floats to the top, containing in solution the whole of the amylic alcohol which might have been contained in the alcohol or spirits under examination. The ether is removed by a pipette, and on leaving it to spontaneous evaporation, will leave behind the amylic alcohol, readily detected by its offensive smell.

Description of a Newly-Invented Apparatus for Preparing Animal Charcoal.—MM. Guilbert, at Eth (Dep. du Nord).—Accompanied by woodcuts.

Preparation of Neutral Perchloride of Iron.—M. Boulhon.—This process may be summarised as follows:—Dissolving of iron in dilute hydrochloric acid, aided by heat; evaporation of the solution obtained, and crystallisation; solution of the crystals in distilled and previously well-boiled water, cooled without contact of air; passing a slow current of chlorine through this solution while in rather concentrated state.

Preparation of Caffeic Acid.—J. Hlasiwetz.—Take of extract of coffee (raw or green), 50 grms.; dissolve in 120 c.c. of tepid water; add 50 grms. of caustic potassa. Boil this mixture for an hour in a large retort provided with a condenser; saturate the potassa with sulphuric acid; shake the mixture three times with fresh quantities of ether; remove that liquid by distillation, when crude caffeic acid is left, which is dissolved in water and purified, by means of animal charcoal. From the above-quoted quantity, 6 grms. of the pure acid are obtained.

Estimation of Bromide of Potassium Mixed with Chloride.—Dr. Baudrimont.—Test the sample qualitatively, first, for carbonate and the presence of iodide, since especially the latter renders the bromide unfit for medicinal use, and its presence would also interfere with the process of analysis to be described. (It should be remembered that 1 grm. of bromide of potassium requires for precipitation exactly 1·428 grms. of nitrate of silver, and that 1 grm. of chloride requires exactly 2·278 grms. of the same nitrate for the same effect). Dissolve 1 grm. of the suspected bromide in 100 c.c. of distilled water; take 10 c.c. of this solution, which precipitate completely, by a solution of nitrate of silver *au centième* (1 part in 100 of water), poured out of a burette graduated so as to be enabled to read off tenths of c.c. If the bromide is pure, 14·2 of the divisions of the burette filled with the nitrate of silver solution will be required; if the salt contains chloride, more of that solution will be required; and, since the perfectly pure chloride would require 22·7 divisions, it is readily found by calculation what amount of chloride the bromide contains.

Adulteration of Sub-Nitrate of Bismuth.—This salt has been of late frequently sophisticated with phosphate of lime (bone-ash). To detect this, the salt in question may be dissolved in nitric acid, and this solution precipitated by carbonate of potassa solution. If the bismuth-salt is pure, it is re-dissolved in excess of that precipitant; but any phosphate of lime present is not rendered soluble by this reagent. Of course other sophistications may exist, and therefore proper tests have to be applied to ascertain the nature of the substance.

Les Mondes, March 17, 1870.

Imperial Society of Sciences at Lille (Nord, France).—Prize of 1000 francs (£40) for the best work on any of the subjects of experimental natural philosophy on which hitherto no monograph has been published (by this Society?); June 1st, 1870. Same-valued prize for a work on clinical thermometry; October 1st, 1872. Gold, silver-gilt, silver, or bronze medals for—An elementary work for schools, on the mechanical theory of heat, and its applications to machinery; researches concerning the different qualities of butcher's meat, with proper elucidation of the cause why inferior qualities of meat are less nutritive, for the same weight, than better ones; description of the simplest means of obtaining proper ventilation in cafés, estaminets, and other rooms, by the aid of the ordinary methods of lighting and heating; renewed study of the chemistry of sugar manufacture (beet-root); renewed study of colouring matters; renewed study on bleaching materials. We have left out all questions belonging to physiology and natural history, as well as those of local importance only.

Pneumodensimeter.—A. de Negro.—Description, illustrated with several engravings, of very great and important improvements effected in Bunsen's apparatus for the estimation of the specific gravity of gases, by determining the duration of their flow through very narrow openings, or through very thin plates. The apparatus, as described, is self-registering.

American Journal of Pharmacy, March, 1870.

Contains the following original papers relating to chemistry and allied sciences:—

Notice of M. Carré's Apparatus for Ice-Making.—W. Procter. It appears from this paper that this invention, wherein ammonia gas liquefied by pressure is applied, is a decided success.

Reaction between Spirit of Nitrous Ether and Bicarbonate of Potassa.—Dr. Rademaker.—The author states that, while keeping sweet spirits of nitre, prepared according to the U. S. P., in a bottle containing, as advised, bicarbonate of potassa in crystals, he observed these crystals change form. On examining the same, and applying tests, he found that nitrite of potassa had been formed, while the liquid which had been prepared with great care, was neutral to begin with and had remained so; no perceptible solution had taken place. Aqueous solution of bicarbonate of potassa readily decomposes the fluid in question.

Assay of a Pure American Opium.—W. Procter, jun.—In 100 parts, this sample, obtained from plants grown from foreign seed, contained—Morphia, 15·75; impure narcotine, 2·0; meconic acid, 5·25; caoutchouc, fatty matter, and resin, 11·00; residue insoluble in benzol (including 0·5 ash). 22·0; matter soluble in water, other than salts of morphia and narcotine (as gum, extractive, &c.), 38·5; water, 5·0. No attempt was made to isolate codeia, narceia, meconine, and the like.

On Sulpho-Carbolic Acid and Sulpho-Carbolates.—W. Procter, jun.—Too lengthy for useful abstraction. An excellent paper for perusal for good methods of preparation of these substances.

Zinc Sulpho-Phenate.—Dr. Hagar.—A lengthy paper on the preparation of this salt for pharmaceutical use.

Solution of Citrate of Magnesia.—B. Rother.—This paper contains an excellent review of the various salts citric acid and magnesia yield, and a good formula for the preparation of a pharmaceutically-useful solution of a citrate of magnesia, soda, and potassa.

This number contains, in addition to the papers alluded to, several good papers of purely pharmaceutical importance.

NOTES AND QUERIES.

Liq. Ammoniæ.—How and what kind of apparatus is used for making Liq. Ammon. Fort. (880), as I want to use some of that strength daily, to make about 2 cwts. of it at once?—J. SPENCER.

Baumé's Hydrometer.—How may I gain a knowledge of the comparison which the common specific gravity glass bears to Baumé's hydrometer and specific gravity glass?—J. T. E.

Alumina.—Can any of your readers tell me whether pure alumina is to be obtained from any source? I have heard that it exists somewhere in Cornwall under the name of "Wavellite," but I can learn no more.—ARTHUR WARNER.

Basic-Salt of Iron.—When a solution of $FeSO_4$ is exposed to the air until no further change occurs, what is the formula of the basic-salt precipitated, and of the acid-salt remaining in solution?—FERROUS SULPHATE.

Dr. Schiebler's Apparatus.—I see that mention is made by Mr. Arnot, in his articles on "Sugar Refining," of Dr. Schiebler's apparatus for the amount of carbonates. I cannot find any description of it in the last edition of Fresenius nor in Griffin's "Chemical Handicraft. Can he give me some idea of the instrument, its price, where procurable, and if applicable for the amount of mineral carbonates?—W. R.

Dissolving Cellulose, &c.—(1) Are there any special conditions required, so that cellulose may dissolve in the ammonia solution of copper, or silk in chloride of zinc? (I kept the latter at about 100° F.) (2). Are there any other solvents easily separated from the colloid, suitable for making the latter give a tenacious film? (The film is required transparent, tough, insoluble in water and unaffected by moderate heat, conditions which the enclosed specimen possesses, but for the objections in its preparation and the expense). (3) Can you give me a cheap method of destroying the smell of methylated spirit? (4) Is there any substance that will render gelatine insoluble in clear, transparent sheets besides the bichromates of ammonia and potash and alum?—BICHROMATE.

MEETINGS FOR THE WEEK.

MONDAY, 28th.—Medical, 8.
—— London Institution, 4.
—— Geographical, 8.30.
TUESDAY, 29th.—Royal Institution, 3. Prof. Rollestos, on "Nervous System."
—— Institution of Civil Engineers, 8.
WEDNESDAY, 30th.—Society of Arts, 8.
—— Ethnological, 8.
THURSDAY, 31st.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."
—— London Institution, 7.30.
—— Royal, 8.30.
—— Philosophical Club, 6.
FRIDAY, April 1st.—Royal Institution, 8. Prof. Roscoe, "Artificial Alizarine."
—— Geologist's Association, 8.
SATURDAY, 2nd.—Royal Institution, 3. Mr. Lockyer, "The Sun."

TO CORRESPONDENTS.

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The report of the Chemical Section of the Glasgow Philosophical Society arrived too late for insertion in this week's number.

B. Silliman.—Received with thanks.

Metallurgis.—Copper should be perfectly pure; any alloy injures its conductivity.

Prof. C. F. Chandler.—Received with thanks.

BOOKS RECEIVED.

Midland Steam Boiler Inspection and Assurance Company. Chief Engineer's Report, with Records of Boiler Explosions, 1869.

Catalogue of Chemical Manufacturers' Machinery, Plant, &c., as made by Robert Daglish and Co., St. Helen's Foundry, Lancashire. 1870. Red cloth.

The Week of Creation, or the Cosmogony of Genesis considered in its Relation to Modern Science. By George Warington. London: Macmillan and Co.

The Fuel of the Sun. By W. Mattieu Williams, F.C.S. London: Simpkin, Marshall, and Co.

Now ready, price 6d.,

Notes from the Laboratory of a Sugar Refinery. By WILLIAM ARNOT, F.C.S. Reprinted from the CHEMICAL NEWS.

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THE CHEMICAL NEWS.

VOL. XXI. No. 540.

CONCERNING

ATOM-FIXING AND ATOM-DISPLACING POWERS.*

By WALTER NOEL HARTLEY, F.C.S.

PART II.

IT is very evident that the secondary atom-fixing powers of nitrogen enter into combination more frequently—that is to say, they are more powerful than the extraordinary atom-fixing powers of chlorine, bromine, and iodine; and as the secondary powers in the nitrogen are those which give trivalent functions to cyanogen, we see why the number and variety of the double cyanides is so extensive—in other words, why cyanogen is more eminently trivalent than the radicles with which it is classed.

Polymerism is the most remarkable feature of cyanogen compounds; the most notable case is that of the three chlorides of cyanogen. Although the existence of the second is somewhat doubtful, still there is a possibility of such a body being obtained.

$$CyCl, \quad Cy_2Cl_2, \quad Cy_3Cl_3.$$

There are at least two ways in which the formulæ for these combinations may be expressed, *e.g.*, either—

I. $'''Cy—Cl'''$

II.
$$Cy—Cl \;\|\; Cy—Cl$$

III.
$$\begin{array}{c} Cl \\ | \\ Cy \\ \wedge \\ Cl—Cy—Cy—Cl \end{array}$$

or—

$Cy'''\equiv Cl'''$

$$Cy—Cl \;\|\; Cy—Cl$$

$$\begin{array}{c} Cl \\ | \\ Cy \\ \wedge \\ Cy—Cy \\ /\quad\quad\backslash \\ Cl\text{——————}Cl \end{array}$$

In the one case, we have only the ordinary atom-fixing powers of the Cl exerted; but, in the second example, the chlorines are combined with each other by virtue of their triad functions.

Here follow a few cyanogen combinations, formulated in consideration of the triadic character of cyanogen.

Simple cyanides showing their power of combining with other cyanides—

$$\begin{array}{c} CN—M \\ \| \\ M—CN \end{array}$$

Ferrocyanides—

$$Fe''.(Cy_6).\overset{VI}{M_4}.$$

According to the general formula before mentioned, relating to the combination of multivalent radicles to form a multivalent molecule—

$$6(Cy''') = \overset{VI}{(Cy_6)}$$

Ferricyanides ..	$(Fe''_2).\overset{IV}{(Cy_{12})}.\overset{X}{M_6}.$
Cyanic acid ..	$(Cy)(HO).$

This body admits of polymerism, for the HO here functions in place of Cl in the primary cyanogen chloride; we may accordingly look for the hydroxyl analogue of Cy_3Cl_3: this we find in cyanuric acid—

$$(Cy_3)'''(HO)_3.$$

Amides—

Cyanamide.. .. .. .. $Cy'''(H_2N)'''$.

The tertiary amide is melamine, $(Cy_3)'''(H_2N)_3$.

Tricyanamide, $(Cy_2N)'''.(CN)'''$, which may be regarded as $(H_2N)(CN)$, in which Cy_2 replaces H_2, or as NCl_3, in which Cy acts in place of Cl, is an unknown substance, and it is scarcely likely that it exists, considering the instability of the chlorides and iodides of nitrogen, to which it would correspond. The cyanide of ammonium is a body of much less stability than the iodide; tricyanamide may, therefore, be expected to be still more changeable than even chloride or iodide of nitrogen. A class of interesting and complicated ammonia compounds are the cobaltamines, such as, for instance—

Purpuro-cobaltic chloride	$10H_3N.CoCl_6.$
Luteo-cobaltic chloride	$12H_3N.CoCl_6.$

These have already been considered by Odling*, who offers a theory of their constitution. Taking CH_2'' as the analogue of NH_3'', the various multiples of ammonia in these complicated molecules are regarded as resembling the multiples of CH_2 in the alcohol radicles; if, then, chloride of ethyl be written—

$$\begin{array}{l} H—CH_2 \\ \quad | \\ Cl—CH_2 \end{array}$$

ammonic chloride of silver may be expressed thus:—

$$\begin{array}{l} Cl—NH_3 \\ \quad | \\ Ag—NH_3 \end{array}$$

Such is the briefest way of stating these views: an extension of them explains more complex ammoniated molecules.

There exists a very large class of substances concerning the nature of which nothing definite in the way of explanation has been offered—I mean the crystalline hydrates.

In classing hydrogen with those metals and other elements having a somewhat marked triadic character, it cannot be made an exception to the law which regulates them; therefore, if the law of Canizzaro and regular atomic displacing power are bases of any value for the classification of bodies, I am of opinion that hydrogen has the same atom-fixing power as chlorine and iodine, &c. Let us regard hydrogen as H'''; then hydroxyl, which, we find, functions as Cl''' or $(H_2N)'''$, will assume the quantivalence represented by $(HO)'''$. The combinations of these radicles with hydrogen then produce—

$$(HCl)'' \quad (H.H_2N)'' \quad (H.HO)''.$$

Observe the case of the bivalent carbon compound, $(CH_2)''$; this undergoes repeated condensations, to form more complex molecules which still remain bivalent. Again, $(H_3N)''$ behaves in a strictly similar manner; and this, too, we find to be precisely the case with water. Thus, by polymerism we may obtain—

$$xH_2O = (xH_2O)'' \text{ or } '';$$

that is to say, any number of molecules of water may be combined to form a molecule with a full combining power equal to 2. It follows, naturally, that we may have sodium carbonate crystallising with 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 molecules of water. We have three parallels in the hydrocarbons, the ammoniated salts and the hydrates—

CH_2''	NH_3''	OH_2''
C_2H_4''	N_2H_6''	O_2H_4''
C_3H_6''	N_3H_9''	O_3H_6''
	&c.	

* On page 109, the line referring to the doubtful $NO''Cl_2$ and the non-existent $PO''Cl_2$ was, in my rough notes, cut out by a pencil-stroke, but, being inadvertently copied, passed into print.

* *Philosophical Magazine*, December, 1869.

$$\begin{array}{lll} H.CH_2 & Ag.NH_3 & Na_2O.H_2O \\ | & | & | \\ Cl.CH_2 & Cl.NH_3 & CO_2.H_2O \end{array}$$

The various sodium carbonates may thus be generally expressed, x being equal to any whole number not exceeding 10:—

$$(Na'''_2CO_3)''.(XH_2O)''.$$

Sodium borate .. .. $(NaHBrO_4)''.(H_{18}O_9)''$.
Magnesium sulphate .. .. .. $(MgSO_4)''(H_{12}O_6)''$.
Crystalline chlorine hydrate .. $(Cl_2)''(H_{20}O_{10})''$.

Now there is a further resemblance between ammonia and water, than that of condensing to form complex molecules—the one may be substituted for the other; not a better illustration of this displacement of NH_3 by H_2O can be brought forward than the equations expressing the passage of melamine into cyanuric acid—

$$\underbrace{C_3H_6N_6}_{\text{Melamine.}} + H_2O - NH_3 = \underbrace{C_3N_5H_5O}_{\text{Ammeline.}}.$$

$$\underbrace{2C_3N_5H_5O}_{\text{Ammeline.}} + H_2O - NH_3 = \underbrace{C_6N_9H_9O_3}_{\text{Ammelide.}}.$$

$$\underbrace{C_6N_9H_9O_3}_{\text{Ammelide.}} + H_2O - NH_3 = \underbrace{2C_3N_4H_4O_2}_{\text{Melanuric acid.}}.$$

$$\underbrace{C_3N_4H_4O_2}_{\text{Melanuric acid.}} + H_2O - NH_3 = \underbrace{C_3N_3H_3O_3}_{\text{Cyanuric acid.}}.$$

Perhaps the more exact statement would be to say that hydroxyl displaced amidogen, which, however, comes to the same thing—

$$\underbrace{C_3H_6N_6}_{\text{Melamine.}} + HO - H_2N = \underbrace{C_3N_5H_5O}_{\text{Ammeline.}}.$$

Anhydrous chloride of magnesium is very difficult to obtain, on account of its very greedy absorption of water. This water cannot be driven off by heat; the action of heat expels HCl and leaves MgO. The reason of this is quite obvious, if we suppose the hydrogen of the water, and the chlorine of the magnesium chloride, to be triadic, for in that case they can combine with each other; and the hydrate of magnesium chloride is then an intelligible compound, giving an intelligible decomposition when heated. For instance—

Magnesium chloride .. $(Mg''Cl_2''')''$.
Hydrate of $MgCl_2$ .. .. $(Mg''Cl_2''')''(H_2O)''$.

$$\begin{array}{l} Mg{=}Cl_2 \\ \| \\ O{=}H_2 \end{array}$$

When heated, $MgO + 2HCl$.

The chlorides of the dyad metals generally have a tendency to unite their chlorine to the hydrogen of H_2O; and hence the remarkable avidity with which chloride of zinc and chloride of calcium seize upon water. The chlorides of aluminium and iron have the same property, the former most markedly, and give, more or less completely, the same decomposition when heated; chloride of calcium disengages a portion of its Cl as HCl at a high temperature.

There is, of course, a possibility of other similarly-constituted bodies acting as bivalent radicles, and uniting to form a molecule without alteration of combining power; thus, chloride of sodium or potassium may play the same part as HCl in sal ammoniac and NH_3 in ammoniated compounds. We do, indeed, possess substances in which KCl and NaCl have this *rôle* allotted them; for instance, there exist the following analogous substances:—

$$\underbrace{(Co_2Cl_6'').(H_{30}N_{10})''.}_{\text{Purpuro-cobaltic chloride.}} \qquad \underbrace{(Ro_2Cl_6)''.(H_{30}N_{10})''.}_{\text{Rhodammonic chloride.}}$$

$$\underbrace{(Ro_2Cl_6)''.(Na_6Cl_6)''.}_{\text{Sodium rhodous chloride.}} \qquad \underbrace{(Ro_2Cl_6)''.\begin{pmatrix} K_6Cl_6 \\ | \\ H_{12}O_6 \end{pmatrix}''}_{\text{Rhodous potassium hydrated chloride.}}$$

We have a further example of water, ammonia, and hydrochloric acid, all in the same molecule, united to Ro_2Cl_6, *e.g.*—

$$(Ro_2Cl_6)''.\left[\begin{array}{c} H_{18}N_6 \\ | \\ H_6Cl_6 \\ | \\ H_6O_3 \end{array}\right]''$$

Similar iridium compounds exist, for instance—

$$(Ir_2Cl_6)''.\begin{pmatrix} Na_6Cl_6 \\ | \\ H_{48}O_{24} \end{pmatrix}'' \qquad (Ir_2Cl_6)''.\begin{pmatrix} K_6Cl_6 \\ | \\ H_{12}O_6 \end{pmatrix}''$$

$$(Ir_2Cl_6)''.\left[\begin{array}{c} H_{18}N_3 \\ | \\ H_6Cl_6 \\ | \\ H_{12}O_6 \end{array}\right]'' \qquad (Ir_2Cl_6)''.(H_{30}N_{10})''.$$

All these bodies, then, have the radicles, H_3N, H_2O, HCl, KCl, and NaCl condensed in the same manner as CH_2 in the olefines, or alcohol radicles, &c. Certain cyanogen compounds have a similar construction; for example, the ferrocyanides and ferricyanides may, perhaps, be thus represented—

$$\underbrace{(Fe''Cy_2)''.\left[\begin{array}{c} CyM \\ | \\ CyM \\ | \\ CyM \\ | \\ CyM \end{array}\right]''}_{\text{Ferrocyanides.}} \qquad \underbrace{\left[\begin{array}{c} Fe''Cy_2 \\ | \\ Fe''Cy_2 \end{array}\right]''.\left[\begin{array}{c} CyM \\ | \\ CyM \\ | \\ CyM \\ Cy{=}Cy \\ MCy \\ | \\ MCy \\ | \\ MCy \end{array}\right]''}_{\text{Ferricyanides.}}$$

I consider that such molecular condensations are not confined to compound bodies; the dyad elements, for instance, in potassium-pentasulphide and iodic and periodic anhydrides have a like behaviour, thus:—

$$(S—S—S—S—S)''.(K_2)''$$
$$(O—O—O—O—O).(I_2)''$$

The triads, likewise, as exemplified in the methylium periodides—

$$I_2''' = (I_2)''\left[\begin{array}{c} Me_3N \\ | \\ MeI \end{array}\right]''.\left[\begin{array}{c} I_2 \\ | \\ I_6 \end{array}\right]''$$

From the consideration of these complex combinations, I am led to classify the monad radicles in the following manner:—

With powers I. and III.—

Metals { H, K, Na, Tl, Au, Ag } Halogens { Cl, Br, I } Compound radicles { H_2N, CN, HO }

These bodies having monad and triad characters, resemble, as a class, nitrogen and its congeners, insomuch as they have two weaker atom-fixing powers.

It may be objected from what I have said concerning the triad nature of hydrogen, that we should expect ammonia to be a saturated molecule, and also that the ammonium-oxygen salts should undergo a similar decomposition to that of the haloid salts; for instance, taking ammonium sulphate, it might be supposed that the two free

* Kekulé. ("Lehrbuch der Organischen Chemie," vol. i., p. 359).

powers of the hydrogens in H_2SO_4 saturate the two free powers of the nitrogens in the ammonia molecules.

$$\left.\begin{matrix} SO_2'' \\ H'''H''' \end{matrix}\right\} O_2$$
$$N\left(\begin{matrix} H \\ H \\ H \end{matrix}\right)'' \quad N\left(\begin{matrix} H \\ H \\ H \end{matrix}\right)''$$

This is, however, not the case; as then we should have five hydrogen atoms united to each nitrogen, a combination which has not yet been effected; and, furthermore, we should be assigning to hydrogen the same intensity of atom-fixing power as Cl, Br, and I. We should thus be overlooking the fact that, in the nitrogen series, those elements with the higher atomic weights are those more powerfully pentadic. (It is true that we have no pentachloride of arsenic or bismuth; but this goes for little against the other evidence of pentad character, when we consider that no terhydride of bismuth exists, yet we have a terethide.) The power of fixing five atoms increases with the atomic weight. In the hydrogen family the same thing is obvious; Au, Tl, and I are more powerfully triadic—they, too, are the elements with the higher atomic weights; consequently we should look for a less markedly triadic character the lower the atomic weight; much less, therefore, should we expect an element with the lowest atomic weight to have so decided a power of fixing three atoms. The reason why we have not a tertiary hydrocyanic acid is on account of the comparatively feeble atom-fixing powers of hydrogen; but we have a compound tending in that direction. Thus, by passing chlorine into HCN, Wurtz obtained this substance—

$$\begin{pmatrix} CyCl \\ CyCl \\ CyH \end{pmatrix}$$

or cyanogen trichloride with one Cl replaced by H.

That the atom-fixing powers of hydrogen are feeble, in comparison with those of chlorine and iodine, is shown by the extreme facility with which the carbonate of sodium, $Na_2CO_3.10H_2O$, under very trifling changes of temperature, and other causes, loses one or more of its molecules of water.

Again, it may be objected that, if H has a triad power, it is less likely to combine with itself than with any other element. I would, to this, answer, no; it appears to me, on the contrary, the extraordinary atom-fixing powers are the true cause of the polymerisation of N, Cy, Cl, I, and H_2O; *e.g.*—

$(Co_2Cl_6).(H_{30}N_{10})\ Cy_3Cl_3\ N\left\{\begin{matrix} Me_4 \\ I_5 \end{matrix}\right.\quad Na_2CO_3.10H_2O$, &c.

In Watts's "Dictionary," it is stated that Kekulé has treated of many of the substances I have mentioned as as molecular compounds, combinations resembling the crystalline hydrates. No definition of the constitution of these bodies is given; but we are told they arise from a juxtaposition of molecules. I will quote, however, a statement from one of Kekulé's publications (*Ann. der Chem. und Pharm.*, vol. civ., p. 133)—"A combination of several molecules belonging to the types, HClHCl, H_2OH_2O, $HClH_2O$, can only take place if, by the entrance of a polyatomicradicle in the place of two or three atoms of hydrogen, a cause of union occurs." This amounts to saying that the crystalline hydrates are not combinations. Now this juxtaposition of molecules must be either a combination of molecules or not; if it be not a combination of molecules, then the resulting body is not a chemical compound, but is such a juxtaposition of molecules as we generally understand by a mixture of liquids or gases bearing no hitherto recognised relation to the atomic weights. On the other hand, if it be a combination of molecules, it is evident the molecules are not previously-saturated compounds, otherwise they would have no combining power, and consequently would not combine; for the combining power of a molecule is dependent on the non-saturated condition of one or more of its constituent atoms. Regarding a combination of SO_3 and KCl, Williamson* makes a similar statement, to the effect that neither the chlorine nor potassium are other than monad elements—they are combined to saturation; yet the two molecules, SO_3 and KCl, are held together by chemical force. Are we to have two kinds of chemical force, one holding together K and Cl, the other uniting So_3 and KCl, or is it only a matter of degree of force exerted, which makes one class of compounds differ from another? I have endeavoured to show that the latter alternative is what I am induced to believe correct.

Somewhat in accordance with what is suggested in this paper are the results communicated to the Chemical Society by Dr. Gladstone, "On Refraction Equivalents."† Some of the elements have a double refraction value, "and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12·0, in the ferric salt, 20·1; and, since the refraction equivalent of iron in potassic ferridcyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts."

My formula given above for ferricyanides is in harmony with this. But amongst those elements with a double value, we find Cl, Br, I, and H; it is not improbable that behind this is lurking the evidence of the truth of my suggestions regarding monad elements. Furthermore, Dr. Gladstone mentioned that NH_4Cl gave numbers equivalent to NH_3 and HCl, which is to be expected if the true constitution be $NH_3''.HCl''$, but not otherwise. The same results may be looked for with $PCl_3.Cl_2$ and $SbCl_3.Cl_2$; for it stands to reason that these bodies do not demonstrate the usual decomposition of chlorides by heat, else we should have the following equation verified:—

$$2CHCl_3 = C_2Cl_4 + 2HCl,$$

a change which the author at one time thought possible, and vainly endeavoured, after repeated trials, to effect. What really takes place is thus represented:—

$$6CHCl_3 = C_6Cl_6 + 6HCl + 6Cl.$$

I should have preferred to have further developed these views, to have sought longer for proofs of their correctness, and placed them in a more carefully-stated form, but I am induced to give them publicity in their crude state, on account of my belief that a tendency of thought towards the same point is rife at the present time in the minds of others. To give an impetus, therefore, to speculation in the same direction, I commit my views to those interested in the subject.

London, March 12th, 1870.

DETERMINATION OF SULPHUR IN IRONS.

By H. B. HAMILTON,
Millfields Iron Works, Staffordshire.

THE following process will, it is believed, be found a convenient modification of that described in Fresenius's "Quantitative Analysis," since it not only dispenses with the trouble of oxidation by fusion, but effects much saving of time. A weighed quantity of iron (for puddle bars not less than 10 grms.) is thrown into a capacious flask, about an ounce of water is added, and the whole agitated to prevent caking in the after process. A cork is inserted into the mouth with two perforations, the one for a thistle funnel with tube and bulb, curved as represented in Fresenius's "Quantitative Analysis," to admit acid; the other for a tube bent at right angles. The latter tube communicates with a U-tube, containing a solution of caustic potash free from sulphate. (I attached another U-tube to the former one, containing a solution of oxide of lead in

* *Proceedings of the Royal Institution*, vol. iv., p. 277.
† CHEMICAL NEWS, vol. xxi., p. 114.

caustic potash.) Sometimes concentrated hydrochloric acid, and sometimes water, are to be poured in at the funnel, according to circumstances. As soon as the action, after pouring enough hydrochloric acid into the flask, has almost ceased, the contents of the latter are to be boiled. The flame is then taken away, and, as soon as the ebullition has ceased, air is sucked through the apparatus for about a minute. This process may be advantageously repeated, if, as will easily be discovered, the action of the acid has not entirely ceased. (After several experiments the second U-tube did not show the slightest blackening.) The contents of the first U-tube are emptied into a beaker, and the U-tube rinsed out with distilled water. A current of chlorine is allowed for some time to pass through the solution, which is then boiled, acidulated with hydrochloric acid, and boiled again, to drive off all hypochlorous acid, when it is precipitated with chloride of barium.

The contents of the flask are filtered through asbestos, and, without washing the residue at all, it is transferred again to the flask, removing every particle from the funnel by means of a small quantity of nitro-hydrochloric acid, After heating, in order to oxidise the black residue with the nitro-hydrochloric acid, water is to be added, and some carbonate of soda, free from sulphate, to neutralise the large excess of acid. After boiling, filter, taking care that the solution is still slightly acid; precipitate with chloride of barium, add the precipitated solution with precipitate to the former one, and proceed in the usual manner.

It will, perhaps, be interesting to some, if I give results of a few of my analyses according to this method:—

	Per cent of S. 1st anal.	Per cent of S. 2nd anal.	Difference.
Sample No. I.	0·038	0·026	0·012
„ No. II.	0·088	0·073	0·015
„ No. III. ..	0·045	0·033	0·012

ON A NEW METHOD OF MANUFACTURING CAUSTIC SODA,

PATENTED BY M. BACHET, OF PARIS.*

By R. CALVERT CLAPHAM, F.C.S.

EXPERIMENTS were made by Lord Dundonald as far back as 1790—1794 in making caustic soda by the decomposition of common salt with litharge. This process was conducted on a manufacturing scale by the late Mr. W. Losh, in 1799, and I am indebted to him for some details of the process then in operation.

The proportions recommended to produce the best results were 100 parts of salt and 300 parts of oxide of lead; but, when the greatest care was taken, they did not succeed in obtaining more than 3·0 parts of caustic soda; or 5·6 per cent of salt was decomposed. At that time, they had many difficulties to contend with in preventing the loss of lead in the solutions; and they had no plan in operation to re-convert the white lead pigment, which was formed back again into an oxide of lead, ready to receive a fresh charge of salt. They had, therefore, to contend with considerable expenses, and some loss of lead in melting it down again to a metallic state. It was only the high price of soda (which may be calculated as equal to £85 to £90 per ton of 70 per cent caustic soda) which enabled the operations to be conducted at a profit. I shall not trouble the Members with any details of the changes which have taken place in the manufacture of soda from that time to the present. It is sufficient to say that, after three-quarters of a century has passed away, a patent has been taken out by M. Bachet, of Paris, for the production of caustic soda by means of salt and litharge, which, in some respects, resembles the old method, but with this marked difference—that hydrate of lime is added to the mixture, which has the effect of preventing the reactions which take place between the soda and the chloride of lead by the old method, resulting in the re-conversion of the chloride of lead into common salt. And the new process also includes a method of regenerating the white lead pigment, so that it may be used over and over again. The experiments I am about to describe have been conducted by the Walker Alkali Company, at Walker, during the past nine months. Many trials were made as to the best mixtures to be used; but, as far as has yet been ascertained, the following produce good results:—

100 parts of litharge,
70 „ salt,
50 „ lime.

About 5 cwts. of this mixture is ground on a mill, a small quantity of water being added to dissolve the salt. It forms a white, pulpy mass, which is ready to be drawn off the mill in a quarter-of-an-hour. Indeed, as far as experiment can prove, it appears as if the decomposition was almost instantaneous; and, if the operation is properly conducted, about 19 to 20 per cent of the salt is converted into caustic soda. It will be seen hereafter how the remainder of the salt is treated. The decompositions on the mill appear to be threefold—the production of caustic soda, of chloride of lead, and of hydrate of oxide of lead; a portion of the salt and the litharge remaining unacted upon. The pulpy material drawn from the mill is pumped into a press, which is worked at a pressure of 145 lbs. to the square inch. A clear liquid runs out, consisting of caustic soda and brine, containing a variable quantity of lead. With the object of separating completely the small quantity of lead from the soda solutions, various plans have been tried.

Sodium sulphide separates the lead easily; but there are some objections to this process.

Carbonate of soda also precipitates it as a carbonate; but, in some cases, for reasons difficult to explain, the action is not certain.

The simplest method which has been pursued is to pass the solution through hydrate of lime in the form of a filter. All the lead is precipitated; and, on testing the filtered solutions, they only give a slight colour when treated with sodium sulphide.

The lime containing the lead is afterwards used on the mill, in the place of fresh lime.

When the liquors are free of lead, they are then evaporated in an iron pan, like an ordinary salt-pan; and the salt which deposits at the bottom is gradually fished out, and may be again used, with fresh oxide of lead, on the mill.

But the process may be varied, so as to produce a much larger decomposition of the salt, by running the liquors from the press back again on to the mill, and adding thereto fresh charges of litharge and lime.

In this way, 47 to 50 per cent of the salt may be decomposed and converted into caustic soda; and a much stronger soda liquor is obtained to evaporate in the pans, a considerable amount of labour and cost of coals being saved. In either case, the solutions are concentrated till they are ready to be run into a caustic pot, where they are finished in the usual way, producing, with ordinary care, a caustic soda of 70 per cent.

We have now finished with the solutions, and must return to the dry white-lead cakes left in the press before described, the treatment of which forms one of the most important features in the patent.

When freed from its soda solutions it consists of—

Chloride of lead,
Hydrate of lead,
Litharge unacted upon,
Lime unacted upon.

* Read before the Newcastle Chemical Society, March 24th, 1870.

As hydrate of lead has no action in decomposing salt, it becomes not only a question of how to decompose the chloride of lead, but also how to convert the hydrate into an oxide which will again act upon salt. The method which appears most likely to effect these ends, is, in the first instance, to dry the material from the press, at a temperature of about 350° F. It turns to a fine orange-yellow colour, and the hydrate is decomposed and is converted into a heavy oxide.

The mass is then slowly thrown into a boiling solution of lime-water, in which the chloride of lead is decomposed, forming chloride of calcium and oxide of lead. This solution is now run off, and after one or two washings in fresh lime-water, the lead is again fit to be used at the mill. The liquors which are run off, however, are not to be thrown away, as they contain lead in solution, and it is necessary to separate it to prevent loss.

This is not a difficult operation, as in the cooling of the hot liquors the lead nearly all deposits in fine long crystals, and the remainder left in the solution is precipitated by means of common salt or hydrochloric acid, so that a mere trace remains on testing with sodium sulphide; the chloride of lead thus obtained is decomposed with lime-water as just described, and the oxide applied to the mill. From this it appears that, with ordinary care, all the lead may be recovered, but it is only fair to allow that, in conducting a large manufactory, a portion will be lost, which requires to be estimated for in the cost of production.

Thus far the process appears to work quite smoothly, but the regenerated lead obtained as above described does not in all cases act the same. Sometimes its action is quite as energetic on salt as the original litharge, but in other cases it has proved less satisfactory when worked frequently over again in the process. The cause of this change is not always sufficiently clear; in some instances, during the heating of the material, Pb 3·04, and Pb 0·2, are formed, both of which, I find, have no action on salt. Another difficulty has been in the rapid absorption of carbonic acid by both the hydrates of lime and of lead, resulting in a product which has not only no action on salt, but appears, to a large extent, to prevent the free action of the oxide of lead. When, however, the process is conducted quickly, the regenerated oxide of lead may be used over and over again more frequently; but, so far as experiment has proved, it appears likely that, after five or six operations, it will be necessary to calcine a portion of it, and this is proposed to be effected as under. It is mixed with water, and the lighter portion syphoned off, settled, and dried. This portion, which is found to contain nearly all the carbonates, is then calcined at a strong red heat, in a furnace constructed with a working bed of hard mountain limestone, but a roof of ordinary fire bricks. It parts with its carbonic acid quite easily at a red heat, and is then ready to be used in the mill again.

Such is briefly an outline of this patent, and the importance of a new process, with the object of producing caustic soda by more direct means than at present exists, cannot be exaggerated. Without taking into account the total production of soda, but confining the calculation to caustic soda alone, we find that 20,000 tons of this article are now made in England, of the value of £350,000 annually. The plant required is not expensive, consisting chiefly of mills, presses, evaporating pans, and furnaces.

On the whole, there appears a reasonable prospect, when M. Bachet's patent is fully worked out in practice, that caustic soda will be made at a considerable reduction in cost on the present plan. But as there are gentlemen present who understand these subjects in all their bearings so well, I now leave the result of the experiments in their hands, and shall be happy to hear their criticisms.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 126).

LESSON V.

THE results of aquatic collecting will require a somewhat different treatment from that recommended in the preceding lessons. Owing to the density of the medium in which the objects are viewed, and the generally diaphanous nature of the organisms themselves, comparatively little use can be made of reflected light as a means of illumination; its employment is, therefore, rather the exception than the rule.

An account of the varied modes of collecting objects of this kind, and their habitats, would almost occupy a volume. For obtaining fresh-water specimens, advantage may be taken of the excursions of the various London and provincial societies. The Quekett Microscopical Club arranges a series of excursions, which take place every fortnight during the summer months; and, as experienced naturalists always accompany these expeditions, the student may derive much practical instruction in the way of collecting and identifying specimens. The microscope should always accompany the student to the sea-side during a temporary residence, and it is well, if possible, to take the usual working instrument, well equipped with objectives and apparatus, and not some small contrivance which has nothing to recommend it but portability. The following works also contain useful information on the subject of marine and fresh-water collecting:—"Handy-Book of Algæ, &c.," Rev. W. W. Spicer; "Beale," p. 146; "The Aquarium, Devonshire Coast, Tenby, &c.," P. H. Gosse; "Seaside Studies," G. H. Lewes; "Marvels of Pond Life," H. J. Slack; "History of Infusoria," A. Pritchard. See also list of microscopical works in "Beale," p. 364.

The preliminary examination of a quantity of aquatic material is generally most conveniently done in a large trough (Fig. 15, vol. xx., p. 181), with a low power, O3,* and *dark-field illumination*, mirror turned aside, or *long-focus spotted-lens;* the paraboloid has too short a focus for this purpose.

A good diagnosis can often be made by examination in the bottle or tube in which the collection is brought home, with the pocket-lens. Many of the larger animals and plants can be distinguished with this low power, and those too small to be distinctly made out can often be identified by a trained eye. Objects in water may be very conveniently examined out of doors with the pocket-lens, if placed between two small pieces of glass (a 3×1 slide cut in half, and the sharp edges smoothed with a corundum rubber, answers well): these can be kept in the waistcoat pocket, ready for use.

Portions required for more minute examination, if on plants, may be detached with the scissors or forceps. Free-swimming animals, and plants, or deposits, may be taken up with a suitable pipette, by closing the upper end with the finger, and bringing the other extremity over the object to be secured. The finger is then to be removed; and the water rushes in, carrying the object with it. The finger is

* Ross's 4-inch objective is very suitable for this kind of work; it defines well, bears a considerable amount of eye-piece power, will take in an object of about 0·4 inch diameter, and is low in price.

again applied, to close the top of the tube, which is then lifted out of the water, and the object transferred to a slide-cell or other convenient vessel.

If the object is very thin, a common slide, covered with a piece of thin glass, will serve for the examination with a tolerably high power. Should the object be liable to injury from the pressure of the cover, a cell may be used, or a hair placed between the thin glass and the slide. In all cases in which the object is required to be kept for some days, the growing-slide (Fig. 16, vol. xx., p. 181) should be used: some of these may conveniently be made with cells attached. The thin trough (Fig 14, vol. xx., p. 181) may sometimes be useful. All these contrivances permit the employment of the parabaloid for dark-field illumination, and also the achromatic condenser. The live-box supplied with most microscopes is sometimes useful, but has the disadvantage, from the height it raises the object above the stage, of preventing the employment of any sub-stage illuminator but the mirror.

It is frequently necessary to subject the substance under examination to pressure. For this purpose, an instrument known as a compressorium is necessary, two of which, more completely fulfulling the requirements of the microscopist than older contrivances, are the invention of the late Richard Beck (*Quarterly Microscopical Journal*, vol. xii., p. 4); we are also indebted to him for a live-trap for confining small active animals within the field of the microscope, without compressing them or otherwise restraining their movements (*Quarterly Microscopical Journal*, vol. xiii., p. 113).

The habits of marine or fresh-water animals may be watched in aquaria, which need not of necessity be expensive: basins and glass jars answer the purpose extremely well. The marine aquarium should always be carefully examined after the introduction of fresh specimens of seaweed, as they usually bring in with them large numbers of minute animals.

The author, instead of throwing away the results of fresh-water collection when done with, places them in a tank in the garden, used for growing aquatic plants, which, although only containing about 200 gallons of water, always yields a rich supply of microscopic objects, most of which regularly breed and appear from year to year.

(To be continued.)

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, March 14, 1870.

Mr. ALEXANDER WHITELAW, Vice-President, in the Chair.

MR. W. R. HUTTON read a paper on "*Canadian Phosphate of Lime, and some other Mineral Phosphates now Used in Making Superphosphate of Lime.*" The author mentioned that many mineral compounds having different characteristics both in physical appearance and in chemical compounds, as well as in results when operated upon, are now used in the manufacture of artificial manures, and referred to the fact that agriculturists are annually making greater demands upon the manufacturers of superphosphate of lime. He stated that, in general terms, the value of a mineral phosphate depends upon the percentage of phosphoric acid contained in it, but if there is any marked quantity of carbonate of lime present, the value of the phosphoric acid is much reduced, owing chiefly to the large quantity of sulphuric acid required to decompose the carbonate of lime before the phosphate can be reduced. The same remark holds true with reference to phosphatic minerals containing iron compounds in combination; the iron takes up its own equivalent of sulphuric acid, and as it is peroxidised a compound is formed which is positively injurious to plant life. Fluoride of calcium is also invariably found in phosphatic minerals, and it, too, requires sulphuric acid, thus increasing the cost of the superphosphate formed, while the gaseous fluorine compounds set free are a source of annoyance. No mineral phosphate has been so extensively employed as coprolites, and none is so little understood and valued by agriculturists. Although agriculturists, and even some manufacturers of manures, are inclined to look suspiciously upon the superphosphate of lime made from coprolites, Mr. Hutton said that his experience went to prove that superphosphate of lime is always of the same chemical value as a manurial agent, no matter what source it is obtained from. After referring to the origin and nature of coprolites, and the extent of the deposits in Cambridgeshire, Bedfordshire, and Suffolk, from which upwards of 200,000 tons are annually raised, the author proceeded to speak of the necessity for additional sources of mineral phosphates being resorted to, and new deposits being brought within the reach of manufacturers of manures, even if brought from other countries. He spoke of the German and Spanish phosphates as being very extensively had recourse to, although not so valuable as the English coprolites. Reference was made to a large and valuable deposit which occurs in South Carolina, and which has recently been brought into notice. Mr. Hutton mentioned that he was supplied some months since with specimens of phosphate of lime from Canada, obtained from a face of the material nearly fifteen feet in width, and presenting, so far as yet examined, an excellent supply of the raw material. The samples differ very much from those phosphatic minerals which are now in use, and seem to indicate that if a sufficiency can be obtained the Canadian mineral will be welcomed by manure manufacturers. Some of the specimens sent were distinct six-sided prismatic crystals, while the other pieces were in masses; but both crystals and masses had a vitreous lustre, the colour on some parts being green and bluish-green, and in other places red. The following analyses were given:—

	Masses.	Crystals.
Phosphate of lime	86·61	90·82
Fluoride of calcium	7·22	5·70
Chloride of calcium	0·06	0·14
Carbonate of lime	4·47	0·38
Moisture	0·08	0·32
Sand	0·10	0·10
	98·54	97·46
Oxide of iron		0·40
		97·86
Specific gravity	3·142	3·166

In a physical point of view this Canadian phosphate differs from all others in being crystalline and not granular; while it differs chemically in containing more phosphate of lime and less carbonate of lime and sand.

A short discussion followed the reading of the paper.

Mr. JAMES MAHONY afterwards read a paper entitled "*A Note on Plate Sulphate of Potash.*" This compound is obtained as a product from kelp, either by direct crystallisation from the lyes, or by solution and crystallisation of the granulate sulphate which is precipitated in the process of boiling down the liquors. When the liquor is about 42 to 44 of Twaddell, it is run into coolers, and in a day or two crystals are formed. The

liquor is again saturated with soft sulphate, and a second crop of crystals is obtained on the first, and so on till a cake of sufficient thickness is produced. This salt is really a double sulphate, a fact first noticed by the late Dr. Penny; but the author of the paper finds that in practice the salt never contains more than from 73 to 75 per cent of the potassic sulphate instead of 78·56, as would be the case if the salts were present in the proportion of three of potassic to one of sodic sulphate. The plates enclose, during the time of their formation, small portions of the mother liquor which, becoming cystallised, account for the presence of chlorides and other salts, and thus diminish the percentage of potash. The well-defined crystals on the surface of the plates are almost pure. One of them examined by the author gave 77·60 per cent of sulphate of potash. Being clearly a double salt, the author said it might be expected that its solution and re-crystallisation would only have the effect of yielding a purer and more typical double sulphate. But this is not the case, for its component salts then become separated from each other in the order of their respective solubilities. Mr. Mahony proved this by operating upon five pounds of ordinary plate sulphate of potash, roughly pounding and dissolving in a sufficiency of boiling water. The insoluble matter was allowed to settle and was separated by a calico filter. The whole of the solution at 25° of Twaddell, was boiled down to 38°, when a pellicle formed on the surface. On analysis the first crystals gave—

$KOSO_3$	86·23
$NaOSO_3$	13·83
	100·06

There was not a trace of chlorine. The salt deposited at the bottom gave—

$KOSO_3$	84·26
$NaOSO_3$	15·66
	99·92

The pellicle of crystals on the surface gave $KOSO_3$ 81·16. After removal of the first crop the mother-liquor was again boiled down to 38° Twaddell, and a second crop of crystals similar in appearance to the first gave—

Crystals	82·09	$KOSO_3$
Bottom	77·65	,,

The operation of boiling down and crystallising was performed six times. In the fifth crop there was a layer of sulphate of potash with large well-defined crystals of sulphate of soda on the top; and the sixth crop was chiefly sulphate of soda. The total quantity of salt removed was 4 lbs. 13 ozs., containing 3 lbs. 10·36 ozs. of pure sulphate of potash, the insoluble and loss amounting to 3 ozs. Sulphate of soda being the more soluble salt of the two was thus shown to remain in the liquor to the last, and, therefore, plate sulphate of potash cannot be classed in the category of ordinary double salts which remain of similar composition on re-crystallisation. In conclusion, the author referred at some length to the phenomenon of phosphorescence observed in the course of the process of crystallisation. He said it was affected by climatal influences, being more brilliant on some nights than others, and thus it might be assumed to be due to the electrical condition of the atmosphere.

A short discussion followed, in the course of which it was suggested that as Mr. Mahony was as accomplished as a naturalist as he was skilled as a chemist, he should give the section a paper on the phenomenon of phosphorescence as illustrated both by crystallising minerals and by the sea.

Votes of thanks were awarded to the authors of both papers.

NOTICES OF BOOKS.

The Private Life of Galileo. Compiled principally from his correspondence, and that of his eldest daughter, Sister Maria Celeste, Nun in the Franciscan Convent of S. Matthew, at Arcetri. London: Macmillan and Co. 1870. 307 pages.

WE are extremely glad to welcome the issue of another life of Galileo; for, although many such have been published, they have, for the most part, appeared in Italy and France, and are but little known in this country. The most detail work is perhaps Albèri's "Opere Complete di Galileo Galilei, which was published in Italy, between 1842 and 1856. In this country, we scarcely know where to look for a work which gives anything like a definite idea of Galileo's works, of his life, and of the times in which he lived; and, although the work before us purports to be confined to his private life, it contains many interesting details in regard to his scientific labours, and his persecution by the Church of Rome.

Galileo was the eldest son of Vincenzio de' Bonajute de' Galilei, a Florentine nobleman, and was born at Pisa, on the 18th of February, 1564. His father appears to have been a man of great culture, and was the author of several works on counterpoint, which, having been invented about the twelfth century, had attained some degree of perfection by the sixteenth. Galileo acquired a great love for music from his father, and is said to have excelled him as a performer on the lute; throughout his life, specially when blindness and bodily ills were added to his other troubles, he delighted in the soothing effect of his instrument. In painting Galileo also excelled, and it is probable that, if he could have chosen his profession, he would have become a painter.

In 1581, at the age of seventeen, Galileo was sent to study medicine at the University of Pisa, an intensely conservative institution, where Aristotle, and Aristotle only, was considered the fountain-head of all knowledge.

It was during his residence at Pisa that he discovered the pendulum. He noticed the extreme regularity of the oscillation of the great bronze lamp in the nave of the Cathedral, and was thus led to imagine that an instrument might be constructed which, by the alternation of its oscillations, would mark the regularity and variation of the pulse. This instrument he constructed, and it was much used by the physicians of the day, under the name of *pulsilogia*.

When we remember how great a mathematician Galileo became, it is strange to learn that the study of mathematics was entirely neglected in the University of Pisa, and, indeed, in Italy generally. It was considered a waste of time to solve problems, and the name of Euclid was almost unknown; indeed, Galileo was obliged to pursue his mathematical studies clandestinely, and it was only when his father saw that he possessed an extreme aptitude for them that he permitted them to be continued. Accordingly, Galileo worked hard at the writings of Euclid and Archimedes; he reached the sixth book of the former, and had already invented several problems. In 1586, while studying the works of Archimedes, he composed his first essay, on the "Hydrostatic Balance," which was not published, however, till 1615. In 1588, he wrote his "Theoremata Circa Centrum Gravitatis Solidarum," which was not published till 1638, and then in the form of an appendix to the fourth of the celebrated "Dialogues." The "Essay on the Centre of Gravity of Bodies" led to the introduction of Galileo to Ferdinand, Grand Duke of Tuscany, who appears to have admitted him to a considerable degree of intimacy. In 1689, Galileo was appointed Professor of Mathematics at Pisa, with a salary of sixty crowns per annum, that is, about ten-pence per day. With one exception, Galileo had not a friend among the Pisan Professors, for they were firm believers in Aristotle; and, when Galileo proved the

Aristotle's laws regarding falling bodies by experiments in public, made on the summit of the Leaning Tower of Pisa, the anger of his colleagues was soon made manifest. In 1592, Galileo resigned the Professorship at Pisa, and became Professor of Mathematics in the University of Padua, with a salary of 180 florins a-year (about £32). The Paduans recognised his genius somewhat tardily: when he had been among them seventeen years, the Senate of the University, bearing in mind his discovery of the telescope, and his labours "to the gain of the University, and to the satisfaction of all," gave him the Professorship for life, with a salary of a thousand florins.

In 1609, Galileo invented the telescope. It was first called *cannochiale* or *occhiale* (eye-glass); and the term *telescope* was introduced by Prince Fredrigo Cesi. The invention was very much combated, even by Galileo's own countrymen; it was claimed by the Dutch, and many older writers (among them Baptista Porta and Antonio De Dominis) were mentioned as prior inventors. By means of the new instrument, Galileo discovered the satellites of Jupiter, in 1610; he called them *Medicea Sidera*, in honour of Cosmo de' Medici and his brothers, Francesco, Carlo, and Lorenzo. Galileo constructed more than a hundred telescopes, and sent them as presents to various monarchs and princes of Europe: only ten of them were capable of showing the satellites of Jupiter. The excitement created by the invention was intense; everyone was anxious to see the new instrument: "we are told how Marie de' Medici, in her eagerness to see the moon through the telescope, would not wait for it to be adjusted, but went down upon her knees before the window, thereby greatly astonishing the Italian gentleman who had brought the telescope into the royal presence." In July, 1610, Galileo discovered Saturn's Ring; in the following October, the phases of Venus; and, in March, 1611, the Solar Spots.

In 1613, Fra Benedetto Castelli, a pupil of Galileo, was appointed Professor of Mathematics at Pisa, but was specially cautioned to make no mention of the Copernican theory of the earth's motion, which, since the discovery of Jupiter's satellites, had been somewhat openly discussed. Galileo wrote to Castelli, during the course of this same year, on the subject of the Copernican theory, and asserted that the Ptolemaic system (then received by the Church) did not, in many respects, accord with Scripture. We may quote a few passages of this celebrated letter in full:—"But I should in your place have added that, though Scripture cannot err, its expounders and interpreters are liable to err in many ways; and one error in particular would be most grave and most frequent if we always stopped short at the literal signification of the words. For, in this wise, not only many contradictions would be apparent, but grave heresies and blasphemies; for then it would be necessary to give God hands, and feet, and ears, and human and bodily emotions, such as anger, repentance, hatred, and sometimes forgetfulness of things past, and ignorance of the future." . . . "And who can assert or sustain that, in speaking incidentally of the sun, or of the earth, or of other created bodies, Scripture should have elected to restrain itself rigorously to the strict signification of the words used? May it not be that, had the truth been represented to us bare and naked, its intention would have been annulled, from the vulgar being thereby rendered more contumacious and difficult of persuasion in the articles concerning their salvation?" A copy of this private letter, obtained, it is believed, by treachery, fell into the hands of the Dominicans of the Convent of S. Mark, and incensed them to such a degree that they determined at once to denounce Galileo to the Holy Office, and, if possible, procure his destruction. The controversy was immediately introduced into the pulpit; and the Dominican Caccini preached a violent anti-Copernican sermon, at S. Maria Novella, on the punning text, "Ye men of Galilee, why stand ye gazing up into Heaven?" The opponents of Copernicus (who, in reality, knew nothing about him) forgot that he was a Canon of their Church, and had been summoned to Rome by Leo X., to the Council of the Lateran, in order to re-model the Church Calendar. Caccini was ordered to repair to Rome, and was examined in March, 1615, in regard to what he knew of Galileo and his followers. Both Caccini and Lorini denounced Galileo to the Holy Office, and thus paved the way to the celebrated trial of 1633. Near the close of the year 1615, Galileo went to Rome to plead his own cause. Early in the following year, he had an interview with the Pope (Paul V.), who conversed with him for three-quarters of an hour, and was altogether very gracious, assuring him that he need fear no persecution by the Congregation of the Holy Office, during his Pontificate. Paul V. died in 1621, and Gregory XV. was elected in his stead, but he reigned only two years; and, in August, 1623, Maffeo Barbarini became Pope, and assumed the title of Urban VIII. When Cardinal, the new Pope had been on somewhat intimate terms with Galileo; had called him "affectionate brother," and had written Latin sonnets in praise of his works. It was hence imagined by the reform party that science would find a patron and protector in Urban; Galileo, indeed, went so far as to hope and imagine that he would recognise the Copernican theory. "Under the auspices of this most excellent, learned, and benignant Pontiff," wrote Prince Cesi, "science must flourish. . . . Your arrival will be welcome to his Holiness. He asked me if you were coming, and when; and, in short, he seems to love and esteem you more than ever." In April, 1624, Galileo started for Rome, where he remained about two months, during which time he had six interviews with the Pope, who gave him various presents on his departure, and "an ample provision of Pontifical love."

Galileo's "Dialogue on the Ptolemaic and Copernican Systems" had for many years been partially written. It was finally concluded in March, 1630; and, in the following May, Galileo went to Rome to make arrangements for its publication. Urban VIII. gave him permission to publish the work with certain slight alterations and additions; but, at the same time, to his great disappointment, told him that the Copernican system could not be recognised by the Church, and must be treated as mere hypothesis. The "Dialoghi" appeared in January, 1632, and was favourably received by all Italy. Suddenly, however, about six months after its appearance, an order was issued from the Master of the Sacred Palace to sequestrate every copy throughout Italy, on the authority of the Jesuit Inchofer, one of the Consultori. The Grand Duke of Tuscany, the principal patron of Galileo, wrote at once to Niccolini, his Ambassador at Rome, to enquire the cause of the sudden change of the Pope's views. Niccolini at once requested an audience. When Galileo was mentioned, Urban became furious: he said he had grossly deceived him, and had dared to publish matters which ought never to have been so much as mentioned; moreover, that the Papal suggestions had not been complied with. The Jesuits ruled the Roman Court then, as now; and certain Jesuits of influence instilled into the Pope's mind the fabrication that, in the person of Simplicio (one of the three characters in the "Dialogues"), Galileo had intended to hold him, the Sovereign Pontiff, up to ridicule. This, once admitted by Urban, sealed the fate of Galileo and of his work. In October, 1632, he was cited to appear at once before the Inquisition; and, although everything was urged against his appearing in person for trial, the Pope would listen to no excuse. Galileo was very old and feeble, and his health was bad. It must be confessed that the three doctors who drew up the medical certificate of the state of his health made the very best case they could for their client, in regard to his unfitness for the journey to Rome. They found him to possess an intermittent pulse and a certain amount of debility; then comes the heaping up of bodily ills—"Riferisce il detto patire di vertigini frequenti, di melancolia hipocondriaca, debolezza di stomaco, vigilie, dolori vaganti per il corpo,

si come da altri può essere attestato. Co se anco haviamo riconosciuto un hernia carnosa grave con attentatum del peritoneo." It was no use, however; the Inquisition would not spare him; and he was forced to make the journey to Rome during mid-winter, through a bleak and dreary region.

Now, his trial and the results thereof, and his abjuration, and imprisonment, and the sentence (which included a recitation of the seven penitential Psalms once a week for three years), are they not written in numerous and diverse books, and, to a greater or less extent, in the minds of all of us? One thing we must allude to, in conclusion: it is usually said that, when Galileo rose from his knees, after abjuring the doctrine of the earth's mobility, he muttered—*Eppure si muove!* ("It *does* move, notwithstanding"). The author of the work before us very justly remarks—"This is one of those fine things which are put into the mouths of great men, but which, in fact, are not said, except by their biographers. It is, indeed, impossible that Galileo should have uttered such words as would have caused his instant consignment to the deepest dungeons of the Inquisition." We remember a recent example of these fine sayings which are put into the mouths of great men. When the Tsar was fired at, in 1867, during his visit to Napoleon III., there were no less than *seven* different statements, in various Paris papers, of the sayings of the Emperor and the Tsar the moment after the shot had been fired. These sayings were so evidently dramatic in their character, and unlike the real remarks which might be expected to be made under such circumstances, that the wonder is they obtained a moment's credence. We remember but one of them—"Sire," said Napoleon III., "we have been under fire together." "Our destinies," replied the Tsar, "are in the hands of Providence." M. Ponsard has not allowed such an incident as the *Eppure si muove* saying to pass unnoticed in his "Galilée;" indeed, he makes it the culminating-point of the drama, and also ingeniously gives Mde. Favart a last chance of showing her filial affection as Antonia—

"*Le President, à Galilée.*
La prison qu'on t'assigne est un cloitre à Livourne,
Antonia, se jetant dans les bras de Galilée.
Va, nous t'y suivrons, père.
Galilée, à part, en se relevant et en frappant du pied en terre.
Et pourtant elle tourne."

Let us add one word, in conclusion, in regard to the treatment of Galileo by the Church, and his actual position. It has been the custom to see in him only an injured and persecuted man; to absorb everything appertaining to the man into the martyr. A lot of nonsense and rant has been written against the Church of Rome, because it suppressed his book; while we forget what our own Church, which pretends to no bigotry, has done; and how, even now, more than two centuries from the time of Galileo, a very little matter of assumed heterodoxy arouses the whole Bench of Bishops, and renders Church literature inflammatory, and often unjust. We need scarcely allude to a recent example of this; and, while it is before us, we may not cry shame on Rome for her treatment of Galileo. Next, as to the man: he is called "the originator of true experimental philosophy," "the father of modern natural philosophy," and so on; some put him before Bacon and Descartes; some assert that he caused the downfall of Aristotelianism. Expressions and ideas of this kind become stereotyped in the human mind. They are bandied about from book to book, and from mouth to mouth; they are accepted without comment; and the full question is rarely examined and weighed. The attitude of human thought in such matters of hearsay and tradition is intensely conservative; its inertia is enormous; its condition of stability is established, and cannot easily be altered. Without doubt, Galileo ranks among the greatest natural philosophers which the world has ever seen: his discoveries are numerous and great; his influence on modern philosophy, although less than that of Bacon and Descartes, was undeniably great. A great many people, however, ignore the fact that Copernicus originated the theory of the earth's mobility, and that there were ten Copernicans in Europe in the sixteenth century, one of whom was our Gilbert, of Colchester. As regards the downfall of Scholasticism, the way had been prepared for this by such men as Aconcio, Nizolius, and Telesius. But most eminent among them all, as one who fearlessly and in the face of persecution asserted the truth and strove to break down the old barriers, was Savonarola. Free thought, and open expression of it, had been practised long before the time of Galileo. The world was ripe for the change. Galileo did not till the soil; he did not even sow the seed; but he helped to garner a mighty harvest. It is right that he should be one of the glories of science; but, to be just, we must not allow enthusiasm to distort our estimate of his chequered and not always admirable life.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, March 21 1870.

The number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Analysis of, and Useful Applications of, Gaize.—H. Sainte-Claire Deville and J. Desnoyers.—There occurs, in the Département des Ardennes, France, a variety of hydrated silica known by the name of gaize, and geologically situated below the cretaceous deposit; the thickness of this layer is 30 metres, and it extends over a distance of 40 kilometres (24·85 English miles). The sp. gr. of this substance is 1·48 in crude state, and after ignition 1·44; in 100 parts, it consists of—Hygrometrical water, 3·4; combined water, 3·2; soluble silica, 43·7; insoluble silica, 40 8; alumina, 3·8; peroxide of iron, 2·9; lime, 0·9 (we only quote one of the very large number of analyses mentioned in this memoir). This stone is used as a building stone; it is, at first, quite soft, so that it can be cut with a knife. Since the authors found that this material resists a very high temperature without fusion or cracking, or, also, of perceptible contraction, either cubical or linear, they recommend it for the manufacture of crucibles (on the lathe), for fire-bricks, and for furnaces. Some specimens of bricks and crucibles made from this material were exhibited at the meeting.

Variations of the Calorific Capacity of Water when Approaching its Maximum of Density (Specific Gravity).—M. Hirn.—A memoir of considerable length, and too full of figures to admit of useful abstraction.

Action of Sulphide of Carbon and Carburetted Gases (*des gaz carburés*) **on Wood Charcoal.**—J. Sidot.—The author describes, at some length, a series of experiments made by him. When the vapours of sulphide of carbon, of wood-spirit, and some of the liquid hydrocarbons are passed over wood charcoal at an elevated temperature, that substance undergoes, at least superficially, a very curious change, and is converted into a sonorous, metallic-looking material, becoming, at the same time, a good conductor of heat and electricity, and no longer capable of absorbing gases; it is, in fact, converted into a peculiar kind of graphite, but only superficially.

On Cobalt and Manganese, and their Alloys with Copper.—A. Valenciennes.—The author exhibits specimens of cobalt and manganese fused in crucibles made of magnesia. The former metal is very similar to iron, but far harder, yet readily wrought in the lathe. Manganese is a very hard, but brittle metal, very readily oxidised in the air; the specimen was pure, having been made from pure peroxide. Notwithstanding the similarity cobalt possesses to iron, the former readily alloys with copper, which iron does not. The alloys of manganese and copper are very similar to those of copper and tin, but very hard and brittle when the proportion of manganese is above 8 per cent of the mixture.

Vertical Beam Galvanometer.—M. Bourbouze.

Electro-Chemical Essay on Ozone.—E. Martin.—This paper was not read—its title only is mentioned.

Nature of the Motive Power which Produces the Phenomena of Endosmosis.—A. Rosenstiehl.—This lengthy memoir, full of quotations from other periodicals, is not well suited for any useful abstraction.

New Method of Preparation of Bromhydric Acid.—MM. Champion and Pellet.—This process is based upon the reciprocal action of the vapours of bromine upon those of paraffin, the latter substance being heated to 185°, and the former to 65°, each in a separate retort. The somewhat complex reaction results, ultimately, in the formation of bromhydric acid, of which, by this means, a concentrated aqueous solution is obtained, which, if saturated at 0° (32° F.), has a sp. gr. of 1·78, and contains, in every c.c., 1·46 grms. of bromhydric acid, while the formula of this compound is $BrH,2HO$. On being heated, gas is evolved; but, simultaneously, a hydrate is obtained boiling at 126°; its formula is $BrH,10HO$; its sp. gr. is 1·48.

Properties of Iodic Acid.—A. Ditte.—This very lengthy and exhaustive memoir treats (1) on anhydrous iodic acid, and (2) hydrated iodic acid. The paper is a monograph on the subject, but not suited for any useful abstraction.

Hydrogenated Derivatives of Sulphide of Carbon.—Aimé Girard.—After referring to older experiments made on this subject, the author states that he has succeeded in substituting hydrogen for half of the sulphur contained in sulphide of carbon, thus constituting a compound containing equal equivalents of carbon, hydrogen, and sulphur. By analysing the compounds this new substance forms with nitrate of silver, chloride of mercury, and chloride of platinum, the author has been enabled to fix the formula of this substance as $C_4H_4S_4$, and that it is bisulpho-methylen. The formula of the platinum compound is—

$$C_{12}H_{12}S_{12},2PtCl + 2(C_{12}H_{12}S_{12})4PtCl_2 =$$
$$= 3(C_4H_4S_4)2PtCl + 6(C_4H_4S_4)4PtCl_2.$$

In 100 parts—Carbon, 12·2; hydrogen, 2·0; sulphur, 32·5; platinum, 33·3; chlorine, 20·0.

Vitality of Beer-Yeast.—J. Melsens.—This lengthy chemico-physiological memoir is divided into the following sections:—Fermentation at 0° (32° F.); freezing of beer-yeast under pressure; freezing of beer-yeast, or of malt, in solution, by means of the paste of ether and solid carbonic acid *in vacuo*; resistance of beer-yeast in wort at a higher temperature; destruction of the vitality of beer-yeast, when the fermentation, produced by it, and going on in a closed vessel, causes the pressure to rise to 25 atmospheres (375 English lbs.) pressure to the square inch. The chief results of the author's researches are—That fermentation is possible in the midst of melting ice, at which temperature seeds do not germinate. Beer-yeast resists (that is, is not deprived of its capability of inducing fermentation) freezing when surrounded by water, and resists the effort of dilatation (expansion) which is so strong as to break vessels capable of resisting 8000 atmospheres' pressure (120,000 lbs.) to the square inch. The energy of the ferment is diminished, but its vitality is not destroyed, by the lowest possible temperature which can be artificially made—viz., about 100° C. below zero. Alcoholic fermentation is suspended when the temperature is maintained for some time at 45° (113° F.). Alcoholic fermentation is arrested, when that operation is going on in closed vessels, as soon as the carbonic acid evolved causes a pressure of 25 atmospheres, and in that case the yeast is killed (*tuée*). The following observations on the contents of this paper were made by M. Bousingault, who says—"It is not at all remarkable that beer-yeast should resist the action of very low temperatures, since the same has been observed with various kinds of seeds purposely exposed to a cold of −100°, which seeds germinated afterwards." But the speaker takes exception to the fact announced that fermentation should go on at a very low temperature, and states that when he repeated, during the very great cold of the winter of 1848, Vergnette's experiments, he found that ferments were killed and fermentation arrested by that low temperature.

Chemical Conditions of the Life of the Lower Organised Animals.—J. Raulin.—A physiologico-chemical paper.

On Tribromhydrine.—L. Henry.—The author describes, at great length, the preparation of this body, which, in pure state, is a neutral, colourless, ethereal liquid, of 2·407 sp. gr. at 10°, insoluble in water, and boiling at 219°; by the aid of a low temperature, it can be obtained in crystalline state. Its equivalent is 281; its percentage composition—Carbon, 12·81; hydrogen, 1·78; bromine, 85·40. Formula, $C_3H_5Br_3$. The author enters into some details on the action of caustic potassa upon this substance, but has not quite finished his researches in this direction.

Isomeric Xylens and Cumens met with in Coal-Tar Oils.—M. Rommier.—A continuation of a former paper on this subject.

Fall of a Meteorite at Mourzouk (Barbary).—M. Coumbary.—The author, writing from Tripoli, states that, on the 25th of December last, there was observed, at Mourzouk (Fezzan), lat. 26° N., long. 12° E. of Paris (14° 20′ 26″ E. of Greenwich), a most extraordinary fall of a meteorite, accompanied by a heavy report of an explosion, and so strong a scintillation of sparks, that a group of Arabs, who were near the spot, became so frightened that they fired their guns at the heavenly monster. The Turkish Government has very laudably taken proper measures to secure the meteorite; but, since the distance from Tripoli to Mourzouk is very great, and the roads hardly fit for traffic, it is a month's journey to reach the latter place. At the end of this letter, it is incidentally mentioned that, in the farther interior of this region (Africa), the Sultan of Wadai, and all the grand personages of his Court, are armed with swords, lance-heads, and sabres made from iron fallen from heaven, which is very abundant there.

Revue des Cours Scientifiques de la France et de l'Etranger March 26, 1870.

This number does not contain any papers relating to chemistry, but we quote the titles of the following memoirs of general scientific interest met with in these pages:—

Existence of Man at the Tertiary Period.—A. Favre.

Spectroscopic Observations of the Solar Protuberances.—G. Rayet.

Action of the Sympathetic Nervous System.—Dr. P. Bert.—A public lecture given to a mixed auditory at the Sorbonne, illustrated with diagrams.

Revue Hebdomadaire de Chimie, March 17, 1870.

Manufacture of Carbonate of Soda.—MM. Schlœsing and Rolland.—This process is based upon the reaction which takes place when carbonate of ammonia reacts upon common salt, both salts being in aqueous solution. There is thus obtained bicarbonate of soda of great purity, which crystallises; and in the solution there remain chloride of ammonium and an excess of the bicarbonate of that base.

Peruvian Guano.—Ch. Mène.—It appears that the Peruvian Government has come to the decision that no guano from the Chincha, Macabi, and other islands, may be exported, except to the United States and the United Kingdom, with the view of settling, by this means, the debts owed by Peru to these countries. The author enters into some details about the fixation of the ammonia in this substance.

Regenerating Stale and Ropy Beer.—M. Mène.—According to this process, the liquids alluded to are boiled up, first, with spent hops, and afterwards fermented again; but it is very difficult to see that this treatment can do any good. It is best to use such fluids as stale and ropy beer either for vinegar making or throw it away into the manure of the horses employed at the brewery, since that is its best place.

Zeitschrift für Chemie von Beilstein, No. 4, 1870.

This number contains the following original papers and memoirs:—

Further Researches on the Constitution of Piperic Acid.—J. Remsen and R. Fittig.—The authors have studied the action of hydrogen, in nascent state, upon piperonal and piperonylic acid. The first of these substances yields, when treated with sodium amalgam and water, three different and well characterised substances, viz.:—Piperonyl alcohol, $C_8H_8O_2$, a solid body, fusing at 51°, crystalline, difficultly soluble in water, readily soluble in alcohol, not volatile without undergoing decomposition, and yielding, with chloride of acetyl a fluid acetic ether. while hydrochloric acid is given off. Hydropiperoine, $C_{16}H_{16}O_6$, a solid body, insoluble in water, and also in cold alcohol; difficultly soluble in boiling alcohol, from which solution it crystallises on cooling, exhibiting lance-shaped crystals fusing at 202°. Isohydropiperoine, $C_{16}H_{14}O_6$, a solid substance, insoluble in cold water, but readily in boiling, very soluble in alcohol, crystalline, and fusing at 138°. The authors describe, at great length, the action of the two last-named substances, in contact with chloride of acetyl and with nitric acid; the result, as regards the latter, being mono-nitro-piperonal, $C_8H_4(NO_2)O_3$, a solid crystalline body, insoluble in water when cold, but better soluble in hot water and boiling alcohol, and fusing at 95°. This very lengthy memoir contains, further, the account of the action of chloride of phosphorus upon piperonal, represented by—

$$C_7H_5O_2 - CHO + PCl_5 = C_7H_5O_2 - CHCl_2 + PCl_3O,$$

producing piperonal chloride, a fluid boiling at between 230° and 240°. By the action of water and dilute hydrochloric acid, piperonylic acid yields protocatechusic acid and pyrocatechin.

Isomeric Nitrotoluols and Toluidines.—F. Beilstein and A. Kuhlberg.—This paper contains the description of the following compounds:—Nitrited acetoluide, $C_7H_6(NO_2),NHC_2H_3O$, a solid substance, fusing at 92°, and insoluble in water; isomeric nitrotoluidine, $C_7H_6(NO_2),NH_2$, a solid crystalline body, readily soluble in alcohol, and fusing at 114°; ortho-nitrotoluol, $C_7H_7NO_2$; ortho-toluidine; ortho-acetoluide, C_7H_7,NHC_2H_3O; dinitrotoluol, $C_7H_6(NO_2)_2$; meta-iodtoluol, C_7H_7I; solid iodnitrotoluol, $C_7H_6(NO_2)I$; chlorotoluidine, $C_7H_6ClH_2N$.

Contributions from the Technical Laboratory of the University of Kasan (Russia).—A. Saytzeff.—This paper is divided into the following sections:—On amyl-ethyl-sulphide; action of zinc-sodium alloy upon a mixture of anhydrous acetic acid and iodide of alcohol (*alcohol jodur*); action of pentabromide of phosphorus upon bromacetyle; a new method for the conversion of fatty acids into the corresponding alcohols; synthesis of normal butylic alcohol; synthesis of alcohol (*Weingeist*); synthesis of normal propylic alcohol; on the proportion of oxygen combining with some of the organic derivatives of bivalent (*zweiwerthig*) sulphur; and on the behaviour of iodide of ethyl towards ethyl-bisulphide.

Action of Ammoniacal Salts upon Oxide of Copper.—J. Tüttschew.—When finely-powdered black oxide of copper, obtained by the ignition of nitrate of copper, is boiled with a solution of chloride of ammonium for a length of time, the oxide loses its colour and becomes greenish; when, after continued boiling, the mixture is evaporated to dryness, and next exhausted with water, a green powder and a bright blue-coloured solution is obtained. This

powder, after having been well washed and dried, first at the ordinary temperature of the air, and lastly in the air-bath at between 120° and 140°, yields, on analysis, for 100 parts—Water, 17·02; chlorine, 16·10; oxide of copper, 70·05. The substance is, therefore, almost exactly similar to the mineral known as atakamite, from Copiapo, Chili, which, according to Dr. Rammelsberg's analysis, is—

$$2(CuCl+3CuO)+9HO;$$

in 100 parts—Chlorine, 15·65; water, 17·88; oxide of copper, 70·00. When the oxide of copper is similarly treated with a solution of sulphate of ammonia, a salt is obtained consisting, in 100 parts, of—Oxide of copper, 67·87; sulphuric acid, 18·73; water, 13·40. Or a substance very similar to the mineral brochantite, from Krisuwaga, Iceland, consisting, in 100 parts, of—Oxide of copper, 67·75; sulphuric acid, 18·88; water, 12·18. With a solution of carbonate of ammonia, which, by-the-bye, is itself decomposed by boiling, a substance was obtained containing, in 100 parts—Carbonic acid, 19·02; oxide of copper, 70·24; water, 10·74. With nitrate of ammonia, a substance is obtained containing, in 100 parts—Oxide of copper, 65·54; water, 18·94; nitric acid (N_2O_5), 15·52; or very nearly the substance, $2(6CuONO_5)+15HO$.

No. 5, 1870.

This number contains the following original papers:—

On M. Wyrouboff's Critical Remarks concerning the Labours of M. Reindel.—Thie paper contains the following sections:—Decomposition of ferrocyanide, by means of nitrate of soda, by crystallochemical reaction; action of chloride of copper on ferrocyanide of potassium. It is not possible to make any useful abstract of this paper.

Adulteration of Rice-Meal.—A. D. van Bastelaer.—According to the author, properly-prepared macerated solutions of flour and meal of wheat, rye, barley, oats, Indian corn, buckwheat, peas and beans, and linseed yield precipitates with concentrated solutions of picric acid. A reaction, due, in all probability, to the action of picric acid upon the albuminous compounds of these substances, which are hardly at all present in rice; and hence the fact that the meal of that cereal yields no precipitate with the reagent alluded to. The method of testing is executed as follows:—20 grms. of the flour to be tested, previously well freed from bran and husk, is mixed with 100 grms. of cold water. and left standing with that fluid, at a temperature of 11° or 12°, for an hour, care being taken to stir the mixture frequently. The mass is next brought on to a filter, and to the filtrate a cold saturated solution of picric acid is added; if this causes, in the case of rice-meal, a precipitate, one may be sure that substance has been adulterated with other meals. The meal obtained from ergot of rye also yields, with picric acid, a precipitate, if treated as above described.

Property of Amorphous Silicic Acid of Absorbing Moisture from the Air.—A. Souchay.—The author states that Dr. Lippert, while assistant to Professor R. Fresenius, made the observation that amorphous silica, after having been strongly ignited in a platinum crucible, attracted moisture from the air to a large extent; in consequence whereof, and to test this fact precisely, the author instituted a series of experiments, from which the following results are drawn:—Amorphous silica is always hygroscopic after ignition; the degree of hygroscopicity differs greatly, according to the degree of heat the silica has been ignited—so that feebly-ignited silica is far more hygroscopic than when strongly ignited. When silica has been only feebly ignited, its avidity for the absorption of water, even after the lapse of a few minutes, is so great as to cause, if not taken into account, serious faults in the weighing and quantitative estimation of that substance. Crystalline silica, even when feebly ignited, is not at all hygroscopic.

Les Mondes, March 24, 1870.

Meteorological Observatory at Montsouris.—To this institution, established by M. C. Sainte-Claire Deville, a grant of £2400 has been made by the French Minister of Public Instruction for the carrent year, with the arrangement that the peculiar work to be done has to comprise—(1) The complete study of all the facts relating to the climate of Paris, and the observation of the phenomena of physical interest pertaining thereto; (2) the calculation and digestion of the older observations on record; (3) the collection and redaction of the daily observations made in France and abroad, as far as they are published or transmitted daily by telegraph; (4) the daily publishing of all the results of observations made.

Technical Education and Instruction.—By decree of the 19th inst., His Majesty the Emperor of the French has, upon the proposition of the Minister for Agriculture and Commerce, approved of the establishment, under the said Minister, of a superior council of technical education, a permanent committee of thirty-two members to be chosen from among the Legislative Assembly, the higher public instruction (professors of universities), the Imperial Conservatory of Arts and Works, the Committee of Arts and Manufactures, the heads of great industrial establishments, the free public instruction, and the Administration (Préfets, Maires, &c.). A sum of £20,000 has been granted to the Minister aforesaid, for the purpose of encouraging technical education; and the committee just alluded to will have to aid and advise the Minister and other parties in the carrying out of a good and useful technical instruction.

A New Aspirator.—Dr. Bleekrode.—This paper is illustrated with a woodcut, absolutely required for the description of a very useful piece of apparatus, which can be readily made with the ordinary appliances at hand in any laboratory, and is so contrived as to admit of permanent action if desired.

Cosmos, March 26, 1870.

Relation between the Variations of the Barometer and those of the Thermometer.—H. H. Hildebrandsson.—A meteorological paper of some importance.

Origin of Petroleum.—V. Meunier.—Three theories exist on this subject, viz.—That the petroleum is the result of the distillation of coal situated within reach of sources of heat of volcanic origin; that it is the result of a peculiar decomposition of substances of animal and vegetable origin; and that petroleum owes its origin to volcanic emanations condensed by pressure and cooling of the superincumbent layers of rock and earths. According (says the author) to researches recently made, it is probable that, since there undoubtedly exists some relation between the deposits of sulphur, petroleum, and rock-salt, the origin of petroleum is due to volcanic agency.

Intended Journey of Russian Scientific Men to the Western Portion of Europe.—A committee of the following gentlemen are preparing for a journey through Germany, France, the United Kingdom, and other parts of Europe, for the purpose of studying the progress made by science in all its branches in Western Europe:—Profs. Chrrouszcrewsky, Kowalewsky, and Hibel, of Kiew University; the Grand Master of Dorpat University, Dr. M. Kepen; Profs. Prachoff and Baraniecky, of St. Petersburgh University; Prof. Sobler, of Moscow University; Profs. Wladiniwoff and Kolosoff, of Charkoff University; Dr. Brandt, of St. Petersburg, and Dr. He, of Kasan University.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869.

The publisher of this periodical informs us that a strike of long duration among compositors and pressmen in a portion of Central Germany has caused a delay of several months in the issuing of this periodical, of which the two numbers now before us (a volume of some 300 pages) contain the following original memoirs and papers:—

Collocation of the Specific Gravities of Aqueous Solutions.—Dr. G. T. Gerlach.—This very useful tabulated form is arranged in the following manner:—At the top of the pages, divided into nine columns, we find, under the figures A, B, C, &c., to I, inclusive—The chemical formula and the equivalent of the substance in solution, in anhydrous as well as in hydrated or crystallo-hydrated state; quantities by weight of the hydrated substance contained in 100 parts of the solution; quantities by weight of the anhydrous substance in 100 parts of the solution; atoms of the anhydrous salt + 100 parts of water by weight; relative volume (bulk) of the solutions, taking the 100 parts by weight of water used for solution = 100 volumes; specific gravity of the solution; volumetrical degrees according to Gay-Lussac; name of the experimenter; temperature, and quotation of the book or periodical where the results here collected have been originally published. As regards the substances here named, they are—Caustic ammonia; caustic potassa and soda; the carbonates of the two last-named bases; chloride of ammonium; chloride of potassium; chloride of sodium; chloride of aluminium; chloride of magnesium; chloride of calcium; chloride of strontium; chloride of barium; chloride of cadmium; chloride of zinc; chloride of tin (SnCl); perchloride of tin; the bromides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; the iodides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; hyposulphites of soda; the sulphates of ammonia, potassa, soda; protoxide of manganese; protoxide of iron; protoxide of iron and ammonia; sulphates of magnesia and potassa ($KO.SO_3+MgOSO_3+6HO$; sulphate of zinc; of copper; neutral and bichromate of potassa; neutral phosphate of soda; basic phosphate of soda; neutral arseniate of soda, $2NaOHO+AsO_5+24HO$; basic arseniate of soda, $3NaO.AsO_5+24HO$; the nitrates of potassa, soda, magnesia, strontia, baryta; oxide of lead; chlorate of potassa; bromates of potassa and soda; iodates of potassa and soda; ferrocyanide of potassium and ferricyanide of potassium; neutral acetate of lead; neutral tartrate of potassa (KO.T); neutral tartrate of soda; tartarus natronatus; tartrate of potassa and soda; hydrochloric acid (ClH); sulphuric acid; sulphurous acid; phosphoric acid; arsenic acid; nitric acid; acetic acid; tartaric acid; citric acid. The paper further contains the following sections:—The legal (gesetzmässig) continuation of the specific gravities of equally-concentrated solutions; changes of bulk which take place during the solution of salts; changes of bulk which take place when aqueous solutions of salts are diluted with water; changes of bulk which take place when different solutions of salts are mixed. There follows next a series of tabulated forms, containing—(1) The specific gravities of almost all hitherto-investigated aqueous solutions of salts, of caustic alkalies, of acids, and of sugar and alcohol. We cannot enter into more details, but should think that, since the portion of text to be translated is very small, these tables might be very usefully published in English in a separate volume, since the collection is highly useful, not only to scientific men, but also to very many manufacturers.

Contribution to the Means of Detecting, and Characteristic Reactions of, Citric Acid.—H. Kæmmerer.—Since the value of this paper rests entirely upon the woodcuts annexed thereto, representing microscopically-observed substances, we cannot enter into any further details.

Reciprocal Method of Calculating Atomic Formulæ, and especially those of Silicates.—Dr. Mohr.—This paper cannot be read without the re-production of a series of tabulated forms belonging to it.

Contribution to the Methods of Analysing Mineral-Water.—Dr. Mohr.—A short paper. Reserved for full translation.

On R. Wagner's Chlorometrical Method.—Dr. Mohr.—A reply to Dr. R. Wagner, who thinks that the author's criticisms on his

(Wagner's) method, as published by the author in his celebrated work on volumetrical analysis, are based on erroneous views.

Analysis of Manganese.—Dr. Mohr.—A short but valuable paper. Reserved for full translation.

Presence of Peroxide of Hydrogen in Air.—H. Struve.—The chief results contained in this paper are—(1) Peroxide of hydrogen is formed in the air simultaneously with ozone and nitrate of ammonia, and is condensed in the meteoric waters; (2) peroxide of hydrogen, ozone, and nitrate of ammonia, are intimately connected together; (3) the change which the so-called ozone-paper undergoes when exposed to air is due to the joint action of ozone and peroxide of hydrogen; (4) peroxide of hydrogen does not decompose solution of iodide of potassium with separation of free iodine; (5) free carbonic acid decomposes the solution of iodide of potassium, causing the formation of carbonate of potassa and free hydriodic acid; (6) when the peroxide of hydrogen is present along with carbonic acid (acting as just alluded to), iodine is separated; (7) the best and most effective reagent for the detection of small traces of peroxide of hydrogen is oxide of lead, since puce-coloured peroxide is formed. The author describes at great length the reactions and the proper application of the same.

[The further contents of this publication are unavoidably postponed till next week.]

NOTES AND QUERIES.

Glycerine.—It will be a favour if you can inform me of a good test, or tests, to ascertain the commercial value of glycerine, and that it has not been adulterated with glucose or other matter.—SUBSCRIBER.

Volatilising Common Salt.—Would any of your readers kindly inform me of the best means of volatilising common salt? Must superheated steam be driven through it, or will an extreme heat be all that is necessary?—ENQUIRER.

Dinitrobenzol.—I shall be glad if any of your correspondents can tell me of a better process for making this substance than those given in "Watts" and "Miller." I have tried them and have not succeeded in making it.—W. H. W.

Liq. Ammoniæ.—(Reply to J. Spencer.)—You can find the description of the apparatus you want in the work on Technology, published by M. Baillière, and edited by Dr. Richardson and Mr. Watts. The work may be inspected at the Library of the Commissioners of Patents. Our space is too limited to describe the apparatus here.

Dr. Schiebler's Apparatus.—(Reply to W. R.)—When the earlier portion of my notes were prepared the fifth edition of "Fresenius" was not published—the publication being almost simultaneous with the appearance of my first paper. For general description of apparatus consult "Fresenius" (4th edition, p. 711). The apparatus I work with was purchased in Berlin, but is, I think, supplied by Dr. Schiebler, Stettin, for 20 Thalers (about £3), complete. It is applicable for all carbonates where carbonic dioxide is the only gas evolved.—W. ARNOT.

Alumina.—(Reply to Arthur Warner.)—Wavellite is not, as you suppose, a native alumina, but the native phosphate of that base. Whether or not any pure native hydrate of alumina occurs in Cornwall, we are not now prepared to say. Under the name of bauxite, a native hydrate of alumina of great purity occurs in the south of France. Kaolin, after thorough calcination, may be made to yield, by treating it with boiling sulphuric acid (sp. gr., 1·384), very pure sulphate of alumina (alum cake); and kaolin is abundantly found in Cornwall. On perusal of our advertising columns, you will find that pure alumina is advertised for sale.

Removing Silica.—(Reply to W. H.)—The silica is present in the carbonate of potassa chiefly as a silicate; and it is stated in the *Handwörterbuch der reinen und ange Wandten Chemie* that digestion of this salt with pulverised charcoal will decompose the silicate. Your best plan, however, is, since it appears that you have to deal with a very crude material, to dissolve it in three-fourths of its weight of cold water, and, after decantation of the solution, leave the residue exposed to air, the carbonic acid of which slowly decomposes the silicate. The aqueous solution obtained should be evaporated to dryness, when it will yield a pretty pure carbonate of potassa.

To Purify Methylated Spirit.—(Reply to "Bichromate.")—Arrange an apparatus as for the continuous distillation of ether, but let the proportion of sulphuric acid be less than is necessary for etherification. Probably there is but little destruction of methyl, but the effect is very materially to sweeten the filthy compound. The distillate is acid, and must be drawn over again, after digestion with carb. of potassa.—R. T. CLARKE.

Dissolving Cellulose.—(Reply to "Bichromate.")—It appears, from the researches of M. Persoz, jun., that the easiest plan for preparing a very active ammonio-cupric solution is to cause strong liquid ammonia to act upon a piece of copper with contact of air, briefly to stir strong liquid ammonia with a piece of copper, until the fluid, of which, now and then, a small sample may be taken for testing, dissolves cotton readily in the cold; wool is insoluble in this fluid in the cold, but is readily dissolved when heat is applied. Chloride of zinc solution of a sp. gr. of 1·718 dissolves silk slowly in the cold, rapidly by application of heat (see, on this subject, J. Persoz's paper in the *Comptes Rendus*, vol. lv., p. 810 (1862), which you can peruse at the Patent Office Library). As to a cheap method of destroying the smell of methylated spirits, you might try re-distillation, after having left the fluid in contact for some time with some quick-lime and well-burned charcoal.

Hardness of Water, &c.—I shall be favoured by an explanation of this anomaly in testing the hardness of water by Clark's standard. Supposing a water requires 32 soap tests to produce a permanent lather for five minutes; such would be called of 16° hardness. Take another water, requiring, say, 34 soap-tests, the hardness of which would be, by the scale, 15 and 4-10ths degrees. Thus—2-34ths degrees = 17 and 17 soap-tests = 7 and 7-10ths degrees, which, multiplied by 2, = 15 and 4-10ths degrees, being actually less than a water requiring but 32 soap-tests, whereas we know that such water would really be harder than the first example! And, query, is the native sulphate, selenite, or the artificial chloride of calcium, preferable as a standard solution?—W. R.

Baumé's Hydrometer.—(Reply to J. T. E.)—You cannot certainly use this hydrometer (better, areometer) for determining the specific gravity of glass. If you want to know that, you could use Nicholson's hydrometer, with weights, which is an instrument made of brass, and sold by instrument makers; or you may determine the sp. gr. of the glass by the well-known methods described in books on natural philosophy. The specific gravity of the glass the hydrometers are made of, whether graduated according to Twaddle's, Baumé's, Beck's, or any other scale, has nothing to do with the instrument as constructed for use; but very frequently the instruments sold are not very well constructed, and mutually differ as to their indications, even at the same temperature. The average sp. gr. of glass varies, according to its composition, from 2·64 to 3·77.—NEMO.

Caustic Soda and Lime.—Perhaps some of your readers will explain the following, as I do not find anything relating to it in any work I have at hand:—Having occasion to use caustic soda in considerable quantities, and finding that unless sufficient lime has been used to decompose the whole of the carbonate of soda, it does not answer my purpose, and wishing to have some means of ascertaining this readily, I thought lime-water might answer on the supposition that if the soda solution contained carbonate of soda the lime would be precipitated as carbonate of lime. I tried several samples with it, each of which produced a white precipitate. I then tried the purest caustic soda I could get at in Manchester, with the same result. I afterwards diluted a sample of commercial caustic soda to sp. gr. 1075, and added lime-water so long as any precipitate was formed, then filtered it, and concentrated the clear liquor quickly to about 1070 sp. gr.; on again adding lime-water to this, the lime was precipitated as before. What I wish to know is whether I am right in inferring that in each case the precipitate was caused by the presence of carbonic acid, and taking that for granted, how is it (as in the instance given) that the solution which would not give any further precipitate should, on concentration, again have that property. Would it be owing to carbonic acid absorbed from the atmosphere?—ENQUIRER.

MEETINGS FOR THE WEEK.

MONDAY, April 4th.—Medical, 8.
—— London Institution, 4.
—— Royal Institution, 3. General Monthly Meeting.
TUESDAY, 5th.—Royal Institution, 3. Prof. Rolleston, on "Nervous System."
—— Institution of Civil Engineers, 8.
WEDNESDAY, 6th.—Society of Arts, 8.
—— Pharmaceutical, 8.
THURSDAY, 7th.—Royal Institution, 3. Prof. Odling, "Chemistry of Vegetable Products."
—— London Institution, 7.30.
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8. Dr. John Hunter, "On the Analysis of Deep-Sea Water." Dr. J. H. Gladstone, "On the Refraction Equivalents of the Aromatic Hydrocarbons and their Derivatives." Prof. How, "On an Acid Feed-Water from the Coal-Fields of Stellaston, N.S., and the Results of its Use."
FRIDAY, 8th.—Royal Institution, 8. Prof. Huxley, "Pedigree of the Horse."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
SATURDAY, 9th.—Royal Institution, 3. Mr. Lockyer, "The Sun."

TO CORRESPONDENTS.

W. R.—Your first letter was in type when your second letter arrived.

Alcohol.—Full directions for the preparation of hydrate of chloral have already appeared in our columns.

J. C. M.—You had better advertise.

W. Arnot.—Received. Many thanks for the trouble you have taken in the matter.

R. W.—Our advertisment-sheet is the proper medium for making your wants known. We can only insert replies to queries which are likely to be useful to our general readers.

A Reader, Redditch.—Consult "Cooley's Cyclopædia of Practical Receipts," published by Churchill.

THE CHEMICAL NEWS.

VOL. XXI. No. 541.

ON THE

LIGNITES OF MIDDLE AND SOUTHERN ITALY.*

By AUGUSTUS A. HAYES, M.D.,
State Assayer of Massachusetts.

SINCE the independence of the Free States of Italy was achieved, scientific explorations have shown the existence of various and considerable natural resources, which may become of great national importance to that country. Among these are numerous deposits of lignite and bitumens; and even sources of mineral oils have been found.

Professor Carlo Cassola, of Naples, one of the most active scientific men of that country, has influenced the present Government so far that aid in the collection of specimens from various localities has been secured; and the parcels sent to Naples now form a large aggregate in the extensive laboratory and museum in charge of Professor Cassola.

Through the kindness of the Professor, I was allowed to examine and analyse some of these samples; and I also visited one of the deposits, a few miles distant from Benevento, in company with himself, scientific friends, and representatives of the Government.

The lignites are found in a formation which represents the tertiary of this country. Clay, conglomerate, and decomposing schists were the immediate enclosing rocks of this locality, and the beds had evidently been broken up and moved from position of deposition by superficial changes.

Some of the lignites presented the varieties of brown coal, with more or less of woody structure visible, and they differed in power of retaining moisture, in gravity, colour, and compactness. One variety was remarkable, inasmuch as it so closely resembled Cannel coal in appearance and general physical characters as to be easily taken for Cannel. It requires, indeed, careful examination to enable one to distinguish it from Cannel; and, as seen, it promised to prove an excellent fuel.

I engaged in the chemical analysis of the Cannel-like variety with great interest, and soon found it to differ remarkably from ordinary lignite, in containing a large proportion of combined water, which was retained after long exposure to a high temperature; indeed, some samples afforded water at 600° F., and the point of complete desiccation did not vary more than 50° F. from the point of temperature necessary to cause decomposition.

An air-dried, selected, average sample of the Cannel-like variety afforded—

Moisture, as given off at 100° to 110° C.	3·40
Water, lost in air at 200° to 230° C. ..	18·20
Volatile combustible matter	29·80
Solid carbon, as compact coke..	43·60
Greyish-white ash	5·00
	100·00

The above composition does not express a valuable fuel; and other samples contain, not only more combined water, but earthy substances also, which would appear as ash in large amount. Indeed, the varieties of these minerals found in Southern Italy, when compared with good laminated coal, as fuel or as a source of power, did not warrant the belief that they can replace coal.

This is a subject of vital importance to a nation wishing to maintain steam-ships upon the ocean, or to carry on those operations in which fuel is an essential element of aid; and every well-wisher of Italy will be interested in the effort now put forth in the search of coal, and in devising substitutes for this mineral suitable for consumption on ship-board. There is much of newly-awakened enterprise and activity of mental ability in free Italy, and the sources of physical well-being and progress were never more carefully scanned in all directions.

In connection with the subject of fuel, it was a happy suggestion of Professor Cassola that led to the mode in which these lignites and hydrous fuels may be burned with advantage. He proposed to mix or saturate the porous lignites with the crude natural bitumens, and burn the nearly-dry artificial mixture thus made as coal, in any ordinary stove or fire-place, on ship-board or in workshops.

The lignites readily absorbed about 20 per cent of the semi-fluid hydrocarbon; and the result was not adhesive, and could be quite as comfortably handled as softer varieties of coal. This mixture, by estimation, had a high practical value, and presented the utilisation of crude petroleum as fuel under a new and inviting aspect.

The burning of any kind of fluid hydrocarbon which can be converted into oils as fuel must be regarded always as a misapplication of a valuable natural production. With this conviction, I had witnessed the experiments made on board a gun-boat of our own Navy, where much invention of a high character had solved the problems and overcome the obstacles presented in burning completely. Yet, unless in other applications the crude material has little value, it can never compete with coal economically.

The bitumens of Southern Italy resemble those of California generally, though their petroleum-oil has been drawn from tolerably-deep wells; and the latter are, therefore, adapted to this new use, becoming valuable, not as fuel *per se*, but in conferring on a poor hydrous-combustible a greatly-increased power in producing heat.

This suggestion of the Professor at once led to application on a useful scale. The Government placed a steamship in order for comparative trials of the new fuel (that is, average lignite which had absorbed about one-fifth of its weight of dark, semi-fluid bitumen, and become nearly dry), and, on the other hand, the best English steam-coal supplied to the Navy, were used in equal weights in producing steam-power. Engagements prevented me from witnessing the trials; but the Admiral's report, expressing the practical results of propelling the ship from point to point of equal distances, gave for the new fuel a value at least equal to that of the best coal, for naval purposes. The mixed fuel, in the trials, was burned in the ordinary coal-furnaces, and did not produce smoke.

This application of Professor Cassola becomes of great importance, therefore, if subsequent search shall show that Italy possesses large deposits of lignite and bitumens; and this mode of utilising hydrous lignites carries with it those practical features which recommend its adoption wherever hydrous fuels and bitumens can meet as products of small value on the spot.

In California, where semi-fluid bitumens exist, the increasing facilities for transportation may allow the value of lignites of that and other states to be greatly increased by the absorption of bitumen, so as to form an artificial fuel in which the combined water of the lignite will be utilised to form a strongly-heating flame in the otherwise smoke-producing vapours of the bitumen.

Boston, Mass.,
December 29th, 1869.

* From the *American Gas-Light Journal*. Communicated by the Author to the CHEMICAL NEWS.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 150).

Lesson VI.

Fibres used in the Manufacture of Clothing, and Analysis of Textile Fabrics.

The materials of textile manufactures may be divided into four classes, two of which are derived from the vegetable and two from the animal kingdom.

The vegetable fibres consist either of hairs or liber cells, a tissue resembling woody fibre.

Of hairs, only those covering the seeds of several species of *Gossypium* (a genus of malvaceous plants) are used in commerce, and are known as *cotton*.

The liber cells are supplied from many sources, and are used for a great variety of purposes, every kind of fabric, from fine linen to cordage, being made from them.

Familiar examples are flax (*Linum usatissimum*), jute (*Corchorus capsularis*), hemp (*Cannabis sativa*), China-grass or rhea (*Bœhmeria nivea*).

The animal materials consist of silk, an albuminous fibre produced by various catapillars.

The remaining class comprises the hairs of those animals which are capable of being either spun or felted—such as wool and its varieties, as alpaca, &c., hairs of rabbit, beaver, &c.

Specimens Required.—Fibres of cotton, flax, hemp, silk, and wool; pieces of calico, muslin, linen, silk, flannel or blanket, and any other woven fabrics and threads procurable; also hairs of various animals.

Examine fibres of cotton, flax, hemp, silk, and wool, as described in Lessons I. and II., with O1 or O½, on stage-plate, by reflected light.

Notice the differences of structure. *Cotton* consists of *flattened, twisted fibres*. *Flax* and *hemp* are *rounded*, with more or less apparent *transverse markings*. *Silk* is conspicuous for the *absence of all structural peculiarities*. *Wool* exhibits a *circular fibre*, with *delicate markings*.

It will be seen that the four classes of fibres have all well-marked characters, and can be readily distinguished from each other under the microscope.

Mount specimens of all the fibres collected, by dry process (vol. xx., p. 193), taking care, as fibrous tissues are very hygroscopic, that they are properly dried. As they will bear a heat not exceeding that of boiling water without injury, the ether process will not be required. Label, and preserve for future reference. Place, also, a small portion of the fibres of cotton, flax, and hemp in separate bottles, with saturated solution of chloride of calcium; leave them to soak for a few days, and then mount in same fluid, taking the precaution to separate the fibres by tearing them apart with needles, so that the single fibres may be well displayed before closing the cell. The silk and wool should be mounted dry, and also in balsam, with as little heat as possible, if transparent specimens are required.

As the mountings in chloride of calcium will be some days in hand, unless the air-pump is used, prepare portions of cotton and flax, on slides, with turpentine, which will render the fibres transparent; and examine with a power of not less than O½ (O¼ will be better), with polarised light, using achromatic condenser and eye-piece analyser (vol. xxi., p. 8). If the condenser is not accessible, the intensity of the illumination may be greatly increased by concentrating the light of the lamp on the concave mirror with the condensing-lens.

The *cotton* will display *more or less colour*, indicating doubly-refractive properties, but *no very marked structural peculiarities*. The *flax* will show *a vast amount of structure*. The transverse markings seen by reflected light will become more conspicuous, and other markings of a more or less spiral nature will, with proper adjustment of the selenites (vol. xxi., p. 9), be rendered visible. These consist of thickenings of the cell wall, known as secondary deposits, and are easily seen by polarised light, owing to their doubly-refractive power differing from that of the thinner portions of the tissue; while, by ordinary transmitted light, they would have been nearly invisible, owing to their transparency. It is much easier to distinguish the fibres of cotton and flax in a mixed fabric by observations with polarised light than by any other means. A power of O1 is quite sufficient when merely the presence of cotton on flax has to be determined.

A careful series of observations on liber cells is much wanted. At present, it is difficult to distinguish between flax and hemp, and other fibres of the same class, so that they might be detected with certainty in mixed fabrics. The chief impediment consists in the very close resemblance of all these fibres to each other. It is, in general, much easier to distinguish them in mass, by various peculiarities of colour, texture, &c., than by the most careful microscopical examination of single fibres.

The action of dyes might reveal some peculiarities connected with these tissues. Experiments on cotton have been tried by Mr. W. Crum, of Manchester. Transverse sections* have been examined by a Continental observer, and, although somewhat difficult to obtain, might be studied with advantage. The whole subject is much in need of investigation.

Woody fibres are used occasionally for purposes of adulteration; an instance is mentioned under silk. A curious case came under the author's notice, in which cotton wick, intended for the manufacture of composite candles, was adulterated with a small quantity (about 5 per cent) of some undetermined liber fibre. Trivial as was the amount of this admixture, it entirely unfitted the wick for the purpose for which it was intended, causing it to remain unconsumed, and accumulate, instead of bending over to the outer part of the flame, and burning away.

For account of liber cells, see—Bentley's "Manual of Botany," p. 30; article, *Liber*, "Micrographic Dictionary," p. 417; *Science Gossip*, vol. ii., p. 10.

(To be continued.)

Andersonian University.—We believe that Dr. Clark, assistant to the late Dr. Penny, who delivered the remainder of the winter course of lectures on Chemistry after that gentleman's death, has been appointed to deliver the summer course; pending permanent arrangements consequent upon the proposal of the President, Mr. Young, to endow a chair of technical chemistry.

* Fibres, hairs, and other long thin substances of which sections are required should be made up into bundles with weak glue, and cut into thin slices with a sharp razor; the sections can be liberated by dissolving the gelatine in hot water.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., President, in the Chair.

THE following Officers have been elected for the ensuing year:—

President—A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents—J. H. Gilbert, Ph.D., F.R.S.; E. Frankland, Ph.D., F.R.S.; A. Mattheissen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.

Secretaries—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

Foreign Secretary—H. Müller, Ph.D., F.R.S.

Treasurer—F. A. Abel, F.R.S.

Ordinary Members of the Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; F. Field, F.R.S.; David Forbes, F.R.S.; M. Holzmann, Ph.D.; E. J. Mills, D.Sc.; W. J. Russell, Ph.D; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; John Tyndall, LL.D., F.R.S.; A. Voelcker, Ph.D.

After having communicated to the Fellows the above list, the President delivered the following address:—

Gentlemen,—On behalf of the Council, I feel very great pleasure in congratulating you on the rapidly-increasing usefulness and prosperity of our Society.

The most interesting incident in the history of the past year has been the delivery by M. Dumas of the Inaugural Faraday Lecture. It was indeed an impressive tribute to the memory of our great countryman which was paid by that noble veteran of science, and one of which the record ought to occupy a place of honour in our Journal. We still hope to receive from M. Dumas a manuscript of his classical discourse.

The Council have had the pleasure of accepting the offer of a munificent donation of palladium from Messrs. Johnson and Matthey, to be used for the preparation of the first ten Faraday medals.

Your Council have felt it to be of considerable importance to give greater publicity to the proceedings of the Society, and they have accordingly made provisional arrangements for the preparation of abstracts of the papers, and, in some cases, of the discussions, for transmission to such papers as desire to publish them. These abstracts already appear in several papers, and are read with interest.

At the time of the last Anniversary Meeting, the Society numbered 522 Fellows. Since that time, 41 new Fellows have been elected, and have paid their admission-fees. On the other hand, six Fellows have been removed for non-payment of fees, one Member (Mr. A. W. Gillman) has withdrawn from the Society, and we have lost five by death. The present number of Fellows is accordingly 551.

The number of Foreign Members at the time of our last Anniversary Meeting was thirty-eight, but of these we have to deplore the death of two, viz., Dr. Otto Linné Erdmann, Leipzig, and Dr. Joseph Redtenbacher, Vienna; so that we now count only thirty-six Foreign Members.

The names of the Fellows who have died during the past year are:—Thomas Graham, Sept. 16th; T. Penny Nov. 22nd; A. B. Northcote, Dec. 28th; E. N. Brayley, Feb.; and I have this morning received intelligence of the death of Julian Courtauld and T. L. Wheeler.

Thomas Graham died September 16th, at his house, 4, Gordon Square.

From an early age, Graham's one great object of life was the discovery of new truths, and he appreciated so fully the value of such work that he resolved to make any personal sacrifices which might be needed for its sake. And nobly he kept his resolution; for, at an early stage of his career, he endured, for the sake of pursuing chemistry, privations and sufferings so severe that they are believed to have permanently injured his constitution; and, at its very end, long after he had attained a world-wide reputation, when his delicate frame sorely needed the repose which was at his command, he continued to labour even more effectively than before, and to enrich science with new discoveries.

It might be difficult to find in history a character so perfect in its noble simplicity and elevation.

Graham was born at Glasgow, on December 21st, 1805, the eldest of a family of seven, of whom only one survives.

He went to the English Preparatory School at Glasgow in 1811, and was there under the care of Dr. Angus. In the year 1814, he was removed to the High School, where, for four years, his studies (which included the Latin language) were directed by Dr. Dymock, and subsequently for one year by the Rector, Dr. Chrystal, under whom he studied Greek. It is said that during these five years he was not once absent at school-time. In 1819, he commenced attendance in the University classes in Glasgow.

Thomas Thomson then occupied the Chair of Chemistry, and young Graham benefitted by his instruction, as, also, by that of Dr. Meikleham, the Professor of Natural Philosophy.

By this time he had already acquired a strong taste for experimental science, and formed a wish to devote himself to chemistry. His father, an able and successful manufacturer, had formed different views for his future career, and wished him to become a minister of the Scotch Church. It is hardly to be wondered at that the father should not have seen in the prosecution of science much scope for an honourable or advantageous career; but young Graham had already seen something of the means afforded by experimental science of getting knowledge from the fountain-head—from Nature herself. He felt the need of more such knowledge to mankind, and his scheme of life was formed accordingly.

After taking the degree of M.A. at Glasgow, he continued his studies for two years at Edinburgh, and there studied under Dr. Hope, and enjoyed the friendship of Professor Leslie. On his return to Glasgow, he taught mathematics for some time, at the suggestion and under the patronage of Dr. Meikleham, and subsequently opened a laboratory, in Portland Street, Glasgow, where he taught chemistry. It is probable that some of the severest trials of his life occurred at about this period.

While absent from Glasgow, he was in the habit of writing regularly and at great length to his mother; and, from the tenour of these letters, it is easy to see what that mother must have been to him. A writer on the social position of women has described the feelings of boys towards their mothers as scarcely amounting to respect! Young Graham's mother seems to have been his guardian-angel, sympathising with his hopes and his sorrows; and certainly his feelings towards her would have been very inadequately described by that frigid word. While studying at Edinburgh, he earned, for the first time in his life, some money, by literary work, and the whole sum (£6) was expended in presents to his mother and sisters.

In 1829, he was appointed Lecturer on Chemistry at the Mechanics' Institution, Glasgow, in place of Dr. Clarke; but the decisive step of his life was in the subsequent year. It was in 1830 that he was appointed Professor of Chemistry at the Andersonian University, Glasgow; and it is said that his mother, who was on her deathbed, lived to hear the glad tidings of his appointment.

He was now more favourably circumstanced for experimental labours; and we find that the seven years spent at the Andersonian University were years of great activity.

In the beginning of the year 1837 died Edward Turner, Professor of Chemistry in the newly-founded London University, now called University College, London. Thomas Graham was the successful candidate for the vacant chair, and in August of the same year we find him already settled in the great metropolis. It was only now that the young philosopher found adequate scope for his abilities. Young men thirsting for knowledge crowded to his lectures, and in those lectures he explained the principles of chemical science with an exactness and clearness never before attained. The success of these lectures was not due to eloquence, nor to any smoothness of diction, for all such matters Graham usually neglected to a degree which in an ordinary person would hardly have been excused. He had a truly philosophical method, which carried away the listener with irresistible force,—the same exactness of thought, the same logical arrangement of matter—in a word, the same purely scientific mind which pervades his work "The Elements of Chemistry." That work which immediately made its author's name known in all parts of the world is too well known to the Fellows of the Chemical Society for it to be necessary to speak here of its great merits. I will merely allude to the successive editions which have appeared in England, the numerous reprints scattered about America, and the translations published in many languages. In Germany, the excellent edition of Fr. Tul. Otto is still the most extensively used and the most valued book of chemical instruction.

Of Graham's investigations that on the phosphates is remarkable in many ways. It was known that solutions of phosphoric acid in water vary in their properties; and chemists were satisfied with giving a name to the changes without investigating their nature. These solutions contained phosphoric acid and water, and were assumed to have like composition. They were accordingly called isomeric. Graham observed that they differ from one another in the proportion of water combined with the acid, and constitute in reality different compounds.

He knew that water combines with acids as other bases do, and he showed that the various compounds of phosphoric acid and water constitute distinct salts, each of which admits of its hydrogen being replaced by other metals without disturbance of what we should now call the type. Thus, to use our present notation, the three hydrates PO_4H_3, $P_2O_7H_4$, PO_3H, correspond to the following proportions of acid and water:—

$$P_2O_5+3H_2O=2PO_4H_3$$
$$P_2O_5+2H_2O=P_2O_7H_4$$
$$P_2O_5+H_2O=2PO_3H$$

Graham observed that the hydrate PO_4H_3 is constituted like a salt, inasmuch as its hydrogen can be replaced atom for atom by other metals, like sodium, potassium, &c., forming such compounds as PO_4NaH_2, PO_4Na_2H, &c.

In order to appreciate duly the powers of mind of the author of this admirable research, we ought to compare his methods of reasoning with those generally prevalent among contemporary chemists, and, on the other hand, with the methods of to-day. One would fancy that Graham had been acquainted with the modern doctrines of types and of polybasic acids, so clearly does he describe the chemical changes in matter-of-fact language, and so consistently does he classify the compounds by their analogies. At that early period we find Graham considering hydrogen, in various salts, as a basylous metal; an idea which, in spite of its undeniable truth, some chemists of the present day have not fully realised.

Amongst minor chemical researches, may be mentioned a series of experiments on the slow oxidation of phosphorus by atmospheric air. He discovered that this process (and the faint light which accompanies it) is arrested by the presence in the air of a trace of olefiant gas, 1-450th of the volume of the air being sufficient for the purpose. Still smaller proportions of some other vapours were found capable of producing this same effect; spirits of turpentine being particularly remarkable, as less than a quarter of a thousandth of its vapour with air was found sufficient to prevent the slow oxidation of phosphorus.

On another occasion Graham investigated phosphuretted hydrogen, and made some remarkable observations concerning the conditions of the formation of the spontaneously inflammable gas. One of these deserves especial notice in connection with the action of olefiant gas, and in preventing the oxidation of phosphorus. He found that phosphuretted hydrogen is rendered spontaneously inflammable by the admixture of a very small proportion of an oxide of nitrogen, probably nitrous acid.

One of the most obscure classes of combinations are those which water forms with various salts. These bodies are characterised by the chief peculiarities which belong to definite chemical compounds; but chemists are, as yet, unable to explain them.

Water so combined is called water of crystallisation, and is said to be physically, not chemically, combined. A very convenient way of getting rid of a difficulty, by passing it on to our neighbours.

Graham examined the proportion of such water of crystallisation in a considerable number of salts, and he moreover examined the properties which it has when so combined. He found that some of the water in an important class of sulphates is held far more firmly than the remainder, and with force equal to that with which water is held in various chemical compounds. He showed that such firmly combined water can be replaced by salts in a definite chemical proportion. In fact, he got fairly hold of the subject by chemical methods, and laid the foundation for an explanation of it.

He discovered and examined compounds of alcohol with salts, and derived from them valuable evidence of the analogy between alcohol and water.

On a later occasion he made a series of important experiments upon the transformation of alcohol into ether and water, by the action of hydric sulphate. Liebig had endeavoured to explain the formation of ether in this process, by representing it as due to the decomposition at a high temperature of a compound of ether previously formed at a lower temperature; such decomposition being due to the increased tension of the vapour of ether at the higher temperature.

Graham justly argued that if the decomposition were due to the tension of ether vapour, it would not take place, and ether would not be formed, if the tension were not allowed to exert itself. He heated the materials in a closed tube, and proved that ether was formed, although the tension of its vapour was counteracted by the pressure thus obtained.

The line of research which occupied most of his attention, and in which his results were, perhaps, the most important, was that of diffusion; and it would be difficult to over-estimate the importance to molecular chemistry of his measurements of the relative velocities of these spontaneous motions of particles of matter, whether in the state of gas or in the liquid state.

It was known that one part by weight of hydrogen occupies the same volume as sixteen parts by weight of oxygen when measured at like temperature and under like pressure. Chemical investigations prove that these equal volumes of the two gases contain the same number of atoms. We also know that the atoms in such a gas are in rapid motion, and resist the pressure to which the gas is at any particular time exposed, by striking against the surface which presses them together with force equal to that which presses them together.

Thus a given volume of hydrogen is maintained against the atmospheric pressure by an energy of atomic motion, equal to that of the same volume of oxygen. Each atom of hydrogen accordingly exerts a mechanical energy equal to that of each atom of oxygen; but we have seen that

the hydrogen atom is much lighter than the oxygen atom, and accordingly it must move with much greater velocity than the oxygen atom.

Now Graham allowed hydrogen to escape through a very small hole in a plate of platinum; and allowed oxygen to escape under similar circumstances. He found that each hydrogen atom moves out four times as fast as each oxygen atom. His experiments were so arranged as to enable him to measure the relative velocities of certain motions of the atoms—motions not imparted to them by any peculiar or unnatural conditions, but belonging to them of necessity in their natural state. He found, moreover, that heat increases the velocity of these atomic motions, whilst increasing the force with which a given weight of the gas resists the atmospheric pressure.

He remained at University College till the year 1855, when he was appointed Master of the Mint, an office which Sir John Herschel had recently resigned. His illustrious friend, Hofmann, from whom I have already freely quoted, shall tell how he discharged these responsible duties.

"It would be difficult to picture the extensive activity which Graham exercised in the high office entrusted to him. The new Master of the Mint showed a circumspection, a mastery of details, an amount of industry and energy, and when occasion required an impartial severity, which astonished every one—more especially some of the officials of the Mint. Such requirements had not hitherto been made, nor such control exercised. A strong resistance was made to the plans of innovation and alteration of the new Master." The author of these lines, Hofmann, at that time held an office in connection with the Mint, and was, therefore, witness of Graham's struggles in his new position. "It was years before he gained a complete victory, and before he was able to return to his favourite study. But at last this longed for period came, and a series of happy years followed. Not an instant was lost. A convenient laboratory was fitted up in the official residence of the Master of the Mint, whose handsome rooms the simple and independent man never occupied, and there his old labours were resumed with greater zeal than ever. Some of Graham's most beautiful researches date from this period. They sprang from the pure love of science. Graham needed to earn no name or position. Both had long been his undisputed property. But the same earnest desire to study nature which in early youth had induced him to bear without murmurs the greatest privations and the bitterest sorrows, still animated him and armed him against the new dangers which threatened his scientific labours from the splendour of his official position and the distractions which it entailed on him."

The study of the condensation of gases by solids, and the combination of soluble compounds with membranes, led him to discoveries which are likely to be of great value to physiologists in explaining processes of absorption and secretion.

Thus he found that oxygen is absorbed to a greater extent than nitrogen by caoutchouc, and that when a bag made of a thin membrane of this substance is exhausted by means of a good air-pump, the oxygen and nitrogen diffuse through it (probably as condensed liquids), and evaporate inside the bag in different proportions from those in which they are present in air; the oxygen rising to over 40 per cent of the diffused air. Again, a mixture of hydrogen and oxygen was separated almost completely by the action of palladium, which condensed the hydrogen in very large quantity, and the oxygen very slightly.

Perhaps the most remarkable substances discovered in the course of his experiments on diffusion were the soluble modifications of tungstic and molybdic acids, ferric oxide, &c., and the process by which these bodies were obtained was, perhaps, the most instructive part of the result; proving, as it does, that in their salts, these bodies have properties different from those which they normally possess in the free state; and retain them when the other constituent is removed by a sufficiently gentle process.

Another remarkable fact which bears on a most important theory, is the separation effected by Graham of potassic hydrate and hydric sulphate, by diffusion of potassic sulphate in aqueous solution—a fact which requires us to admit that the solution of the salt in water contains those products mixed with one another; just as much as the experiment of diffusing air through a porous clay pipe, and getting its constituent in a different proportion from that of the original air, proved that air is a mixture and not a compound of the two gases.

The phenomena of the diffusion of gases and liquids do not astonish us by their brilliancy and variety; but the immense importance of this region of experimental science dawns upon us when we remember that there is no so-called vital process which cannot ultimately be referred to a chemical process, that more or less intense chemical action takes place at all points of the frame of animals and plants, and that an essential condition of this action, and of life itself, is the carrying to and fro of materials, not only by muscular and ciliary action, but in a more intimate measure by diffusion.

In many of his ideas Graham was in advance of his contemporaries, and it might be difficult to find a chemist who has dealt more cautiously with general questions and delicate experimental operations,—or one whose results, in each direction in which he has worked, may more safely be expected to stand the test of future investigations.

The proceedings of the meeting terminated with a vote of thanks to the President for the able and effective manner in which he had discharged his official duties during the past year.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 22nd, 1870.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

THE following extract of a letter, dated March 21st, 1870, from Sir W. THOMSON, D.C.L., F.R.S., Hon. Member of the Society, to the President, was read:—

I have now, at last, got into good working-order measurements of electrostatic capacity (which, perhaps, you may remember I was working on the first time you ever came to see me, and more or less almost ever since). I have two students of last year, junior assistants in my laboratory, measuring electrostatic capacities of condensers, and variations of specific inductive capacities of resistance, with sensibility of 1-10th per cent, and with constancy, in spite of accidental variations, generally within ½ or ¼ per cent.

My occupation on the kinetic theory of gases has led me, at last, to come to definite terms as to the size of molecules. Ever since about the first year of my Professorship, I have taught my students that Cauchy's theory of dispersion proves heterogeneousness, or molecular structure, to become sensible in contiguous portions of glass or water of dimensions moderately small in comparison with the wave-lengths of ordinary light. I have spoken to you also, I think, of the argument deducible from the contact-electricity of metals. This, I now find, proves a limit to the dimensions of the molecules in metals quite corresponding to that established for transparent solids and liquids by the dynamics of dispersion. In experiments made about ten years ago, of which a slight sketch is published in the *Proceedings of the Literary and Philosophical Society of Manchester*, I found that a plate of zinc and a plate of copper, kept in metallic connection with one another (by a fine wire or otherwise),

act electrically upon electrified bodies in their neighbourhood, and upon one another, as they would if they were of the same metal and kept at a difference of potentials equal to about three-quarters of that produced by a single cell of Daniell's. Hence, and from my measurement of the electrostatic effects of a Daniell's battery, published in the *Proceedings of the Royal Society* for February and April, 1860, I find that plates of zinc and copper, held parallel to one another at any distance (D) apart which is a small fraction of the linear dimensions of their opposed surfaces, and kept in metallic communication with one another, exercise a mutual attraction equal to—

$$2 \times 10^{-10} \times \frac{A}{D^2} \text{ grms. weight.}$$

Hence, if they were allowed to approach from any greater distance (D') to the distance D, the work done by their mutual attraction is—

$$2 \times 10^{-10} \times \frac{A(D'-D)}{D'D} \text{ centimetre grms.;}$$

which, if D is very small in comparison with D', is very approximately equal to—

$$2 \times 10^{-10} \times \frac{A}{D}$$

Now, suppose a pile to be made of a great number (N+1) of very thin plates alternately of zinc and copper, kept in metallic connection while they are brought towards one another. Let their positions in the pile be parallel, with narrow spaces intervening. For simplicity, let the thickness of each metal plate and intervening space be D. The whole work done will be—

$$2 \times 10^{-10} \times N\frac{A}{D}$$

The whole mass of the pile, if we neglect that of one of the end plates, is $NAD\rho$, where ρ denotes the mean of the densities of zinc and copper. Hence, if h be the height to which the whole mass must be raised against a constant force equal to its weight at the earth's surface, to do the same amount of work, we have—

$$NAD\rho h = 2 \times 10^{-10} \times N\frac{A}{D}$$

which gives—

$$h = \frac{2 \times 10^{-10}}{\rho D^2}$$

or, as $\rho = 8$, nearly enough for the present rough estimate,

$$h = \frac{1}{(200000D)^2}.$$

Hence, if—

D = 1-200,000th centimetre,
h = 1 centimetre.

The amount of energy thus calculated is not so great as to afford any argument against the conclusion which general knowledge of divisibility, electric conductivity, and other properties of matter, indicates as probable—that, down to thicknesses of 1-200,000th of a centimetre for the metal plates and intervening spaces, the contact electrification, and the attraction due to it, follow with but little, if any, sensible deviation the laws proved by experiment for plates of measurable thickness with measurable intervals between them. But, let D be 1-200,000,000th of a centimetre: if the preceding formulæ were applicable to plates and spaces of this degree of thinness, we should have—

h = 1,000,000 centimetres, or 10 kilometres.

The thermal equivalent of the work thus represented is about 248 times the quantity of heat required to warm the whole mass (composed of equal masses of zinc and copper) by 1° C. This is probably much more than the whole heat of combination of equal masses of zinc and copper melted together; for it is not probable that the compound metal, when dissolved in an acid, would show anything approaching to so great a deficiency in the heat evolved below that evolved when the metallic constituents are separately dissolved,* and their solutions mixed. But the experiment should be made Without any such experiment, however, we may safely say that the fourfold amount of energy indicated by the preceding formula for a value of D yet twice as small is very much greater than any estimate which our present knowledge allows us to accept for the heat of combination of zinc and copper. For something much less than the thermal equivalent of that amount of energy would melt the zinc and copper; and, therefore, if in combining they generated by their mutual attraction any such amount of energy, a mixture of zinc and copper filings would rush into combination (as the ingredients of gunpowder do) on being heated enough in any small part of the whole mass to melt together there. Hence we may infer that the electric attraction between metallically-connected plates of zinc and copper of only 1-400,000,000th of a centimetre thickness, at a distance of only 1-400,000,000th of a centimetre asunder, must be greatly less than that calculated from the magnitude of the force and the law of its variation observed for plates of measurable thickness, at measurable distances asunder. In other words, plates of zinc and copper, so thin as 1-400,000,000th of a centimetre, and placed at as short a distance as 1-400,000,000th of a centimetre from one another, form a mixture closely approaching to a molecular combination, if, indeed, plates so thin could be made without splitting atoms.

Wishing to avoid complication, I have avoided hitherto noticing one important question as to the energy concerned in the electric attraction of metallically-connected plates of zinc and copper. Is there not a change of temperature in molecularly-thin strata of the two metals adjoining to the opposed surfaces, when they are allowed to approach one another, analogous to the heat produced by the condensation of a gas, the changes of temperature produced by the application of stresses to elastic solids which you have investigated experimentally, and the cooling effect I have proved to be produced by drawing out a liquid film which I shall have to notice particularly below? Easy enough experiments on the contact-electricity of metals will answer this question. If the contact-difference diminishes as the temperature is raised, it will follow from the second law of thermodynamics (by reasoning precisely corresponding with that which I applied to the liquid film in my letters to you of February 2nd and February 3rd, 1858†) that plates of the two metals, kept in metallic communication and allowed to approach one another, will experience an elevation of temperature; but, if the contact-difference increases with temperature, the effect of mutual approach will be a lowering of temperature. On the former supposition, the diminution of intrinsic energy in quantities of zinc and copper, consequent on mutual approach with temperature kept constant, will be greater, and, on the latter supposition, less than I have estimated above. Till the requisite experiments are made, farther speculation on this subject is profitless; but, whatever be the result, it cannot invalidate the conclusion that a stratum of 1-200,000,000th of a centimetre thick cannot contain in its thickness many, if so much as one, molecular constituent of the mass.

Besides the two reasons for limiting the smallness of atoms or molecules which I have now stated, two others are afforded by the theory of capillary attraction and Clausius's and Maxwell's magnificent working out of the kinetic theory of gases.

In my letters to you already referred to, I showed that the dynamic value of the heat required to prevent a bubble from cooling when stretched is rather more than half the work spent in stretching it. Hence, if we calculate the work required to stretch it to any stated extent, and multiply the result by $\frac{3}{2}$, we have an estimate, near enough for my present purpose, of the augmentation of energy

* Will you try this experiment? You would easily make a good thing of it.

† *Proceedings of the Royal Society* for April, 1858.

experienced by a liquid film when stretched and kept at a constant temperature. Taking 0·08 of a gramme weight per centimetre of breadth as the capillary-tension of a surface of water, and, therefore, 0·16 as that of a water-bubble, I calculate (as you may verify easily) that a quantity of water, extended to a thinness of 1-200,000,000th of a centimetre, would, if its tension remained constant, have more energy than the same mass of water in ordinary condition by about 1100 times as much as suffices to warm it by 1° C. This is more than enough (as Maxwell suggested to me) to drive the liquid into vapour. Hence, if a film of 1-200,000,000th of a centimetre thick can exist as liquid at all, it is *perfectly certain* that there cannot be many molecules in its thickness.

The argument from the kinetic theory of gases leads me to quite a similar conclusion.

NOTICES OF BOOKS.

First Report of the Commissioners Appointed in 1868 *to Inquire into the Best Means of Preventing the Pollution of Rivers. (Mersey and Ribble Basins.)* Vol. i. 1870.*

WE have here a folio volume of some 140 pages, containing, as may be imagined, an enormous amount of condensed useful and highly interesting information. The work is divided into two main parts—viz., River Pollution (sub-divided into two sections—A, Descriptive; B, Remedies) and Water Supply. The River Pollutions are classed under two heads—viz., Sewage and Manufacturing Refuse. The chemical difference between polluted and unpolluted water is clearly defined as follows:—

"Absolutely pure water is not to be found in nature. Even at the moment of its condensation in the atmosphere from invisible vapour to visible cloud, water absorbs gases, and becomes also contaminated with a fine dust which is everywhere floating in the air. When it falls to the earth as rain, it percolates through strata, or flows over surfaces more or less soluble, and dissolves, according to circumstances, quantities of solid matter varying generally from about 3 lbs. to 50 lbs. in 100,000 lbs. of water. In addition to these inevitable impurities, natural and unpolluted water is not unfrequently turbid from insoluble substances suspended therein in a finely-divided condition.

"The following are the chief characteristics of unpolluted water:—It is tasteless and inodorous, possesses a neutral or faintly alkaline reaction, rarely contains in 100,000 lbs. more than ½ lb. of carbon and 1-10th lb. of nitrogen in the form of organic matter, and is incapable of putrefaction even when kept for some time in close vessels at a summer temperature.

"Of the different kinds of pollution affecting rivers, animal organic matter, as it occurs in sewage, is that which renders water not only most offensive to the senses, but most likely to injure health, both by its gaseous emanations and by its deleterious effects when used as a beverage. Rivers so polluted frequently contain from 1 lb. to more than 2 lbs. of organic carbon, and from ½ lb. to ¾ lb. of organic nitrogen, in 100,000 lbs. Pollution by vegetable organic matter, such as that caused by dye and print-works, stands next, as regards offensiveness; water so polluted being excessively unpleasant, not only to the sight, but also, in warm weather, to the sense of smell. It often contains, in 100,000 lbs., twice as much organic carbon as is present in water polluted by sewage, but, owing to the comparatively small proportion of nitrogen in vegetable substances, it rarely contains more than one-third of a pound of organic nitrogen. Chemical works contribute chiefly mineral impurities, which often communicate to water extreme hardness and other disagreeable and even poisonous properties."

The following is a brief summary of the chemical researches instituted:—

"(*a.*) The total amount of solid matters present *in solution*:—The most important constituents of these solid matters are—

"1. Organic carbon.

"2. Organic nitrogen.

"3. Ammonia in the form, chiefly, of carbonate of ammonia.

"4. Nitrogen in the form of salts of nitric acid and nitrous acid.

"5. Total combined nitrogen.—This determination sums up the whole of the analytical evidence against the water, as regards both past and present organic contamination.

"6. Chlorine. The proportion of chlorine in water may often be used as an indication of the extent to which a stream has been contaminated with *sewage*, as distinguished from *solid* animal matters. The chlorine in river water is almost always combined with sodium as common salt, which is a large and essential constituent of urine, and consequently of sewage, whilst it is present in only comparatively minute quantity in solid manure. It is scarcely necessary to say, however, that the determination becomes valueless for this purpose in the neighbourhood of the sea and of natural deposits of salt—such as that existing in the valley of the Weaver, for instance. The normal proportion of chlorine, as common salt, existing in this country in waters which have never been polluted by excrementitious matters, is about 1 part in 100,000 of water. Most of this is probably carried from the ocean to the land through the air as sea-spray or fine particles of salt; for we find that the unpolluted waters of an inland country like Switzerland contain only about 0·2 part of chlorine in 100,000 parts.

"7. Hardening constituents.

"(*b.*) The total amount of solid matters *in suspension*:—In this it is very important to distinguish between organic and mineral matters. We have therefore determined—

"1. The organic matters in suspension.

"2. The mineral matters in suspension."

The alleged self-purification of polluted rivers, a subject of paramount importance, is treated of in the following terms:—

"At the time the winter samples were taken, the rivers were not in a state of putrefaction; any purification which they underwent during their progress towards the sea was, therefore, produced at this time either by the oxidation of the polluting organic matter contained in the solution, or by the subsidence of the suspended matters. It has often been stated, but, so far as we know, without any proof, that the organic matter contained in sewage and other similar polluting materials is rapidly oxidised during the flow of a river into which such materials are discharged. Thus, it has been asserted ("Report of Royal Commission on Water Supply," p. 79), that if sewage be mixed with twenty times its volume of river water, the organic matter which it contains will be oxidised and completely disappear whilst the river is flowing a 'dozen miles or so.' We thought it very undesirable that a subject of such vital importance to our inquiry should any longer rest upon mere opinion, and we therefore determined to submit it to careful experimental investigation. During our winter visit to the basins of the Mersey and Ribble, a very favourable opportunity presented itself for the solution of this important problem. The river Mersey, after receiving the drainage of many towns and manufactories above the Stretford Road Bridge, flows thence 13 miles, to its junction with the Irwell, without encountering any other material source of impurity, although its volume is somewhat augmented by unpolluted affluents. The river Irwell, after passing Manchester, falls over a weir at Throstlenest, and runs 11 miles, to its junction with the Mersey, without further material pollution, and with but very unimportant unpolluted affluents. Lastly, the river Darwen, which is greatly polluted by the sewage of Over Darwen, Lower Darwen, and Blackburn, joins the Blakewater just below the latter town, and then flows 13 miles, to near its junction with the Ribble at Walton-

*The Commissioners are Dr. Frankland, F.R.S., Sir William Denison, F.R.S., and Mr. J. C. Morton.

le-Dale, without any further pollution, although its volume becomes more than doubled in this part of its course by the accession of the river Roddlesworth, the Alum-House brook, and numerous small affluents, all of which are unpolluted.

"We took samples of water at the top and bottom of the courses of these rivers at the places just indicated, viz.—1. The Mersey at Stretford Road Bridge, and again just before its junction with the Irwell. 2. The Irwell, as it fell over the weir at Throstlenest, and again just before its junction with the Mersey; similar samples of this river being also taken in May and June following. 3. The Darwen, one-third of a mile below its junction with the Blakewater, and again 50 yards above the bridge at Walton-le-Dale."

The main result of these experiments is summarised in the following words:—

"It is thus evident that, so far from sewage mixed with 20 times its volume of water being oxidised during a flow of 10 or 12 miles, scarcely two-thirds of it would be so destroyed in a flow of 168 miles, at the rate of 1 mile per hour, or after the lapse of a week. But even this result is arrived at by a series of assumptions which are all greatly in favour of the efficiency of the oxidising process. Thus, for instance, it is assumed that the 62·3 per cent of sewage is thoroughly oxidised and converted into inoffensive inorganic matter; but the experiments showed that, in fact, no sewage whatever was so converted or destroyed, even after the lapse of a week, since the amount of carbonic acid dissolved in the water remained constant during the whole period of the experiment; whilst, if the sewage had been converted into inorganic compounds, the carbonic acid, as one of these compounds, must have increased in quantity.

"Thus, whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of sewage when the latter is mixed with fresh water and violently agitated in contact with air, or, finally, the rate at which dissolved oxygen disappears in water polluted with 5 per cent of sewage, we are led, in each case, to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness, even when the sewage is mixed with a large volume of unpolluted water, and that it is impossible to say how far such water must flow before the sewage matter becomes thoroughly oxidised. It will be safe to infer, however, from the above results, that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation."

This is confirmed by the evidence given by Sir B. Brodie, before the former Rivers Pollution Commission, in the following words:—

"I should say that it is simply impossible that the oxidising power acting on sewage rnnning in mixture with water over a distance of any length is sufficient to remove its noxious quality. Taking the case of Oxford: if the sewage of Oxford was, in its entirety, discharged into the river Thames, I should say that we could certainly not trust to the oxidising power to take away the noxious quality of the water before it reaches, say, Teddington. I presume that the sewage could only come in contact with oxygen from the oxygen contained in the water, and also from the oxygen on the surface of the water; and we are aware that ordinary oxygen does not exercise any rapidly-oxidising power on organic matter. I believe that an infinitesimally-small quantity of decayed matter is able to produce an injurious effect upon health; therefore, if a large proportion of organic matter was removed by the process of oxidation, the quantity left might be quite sufficient to be injurious to health. With regard to the oxidation, we know that, to destroy organic matter, the most powerful oxidising agents are required; we must boil it with nitric acid and chloric acid and the most perfect chemical agents. To think to get rid of organic matter by exposure to the air for a short time is absurd."

(To be continued.)

CORRESPONDENCE.

ACTION OF IODINE ON HYPOSULPHITE.

To the Editor of the Chemical News.

SIR,—In reply to the letter of Mr. E. Sherer in the CHEMICAL NEWS (vol. xxi., p. 141) I have to say that my experiments on the action of iodine and hyposulphite solutions were performed immediately after his paper, "On the Estimation of Manganese Ores," was read before the Newcastle Chemical Society (Nov. 25th, 1869), and were sent to that Society before the appearance of his further note on the subject in the CHEMICAL NEWS (vol. xxi., p. 48). His statement, that the increased amount of iodine formed on allowing the liquid obtained in Bunsen's process to stand some hours "was caused by the conversion of iodine into hydriodic acid" *(sic)*, did not appear in the original paper read in Newcastle.—I am, &c.,

C. R. A. WRIGHT.

Washington Chemical Works, Durham,
April 2, 1870.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—I was just going to answer the objections which Mr. Gibbins made, in the CHEMICAL NEWS (vol. xxi., p. 132), to my proposed improvement in the manufacture of sulphuric acid, when I saw the letter of Mr. P. Spence, stating that he has already tried, in his large chemical works, some experiments on the subject. Mr. P. Spence answering, in every respect to my full satisfaction, the objections of Mr. Gibbins, I have only few words to add.

For the last three years, a great number of vitriol chambers here work at a high specific gravity; but they are arranged different from those of Mr. Spence. The sulphurous acid comes in contact with the nitric acid in a little chamber of a capacity of scarcely 100 cubic metres (called, in France, *tambour*); it is in this chamber that the action of the two acids takes place. No aqueous vapour, or very little, is introduced in this chamber, and the vitriol manufactured is kept at a specific gravity of 1·715. When this chamber is first set at work, there is no doubt that a layer of sulphate of lead is formed; but, as no aqueous vapour is introduced, it remains on the lead, and protects it against a further action. I have cut out a piece of lead of 10 c.c. after a trial of three years, and I found that it weighed as much as an equal piece of lead of a chamber which, during the same lapse of time, worked otherwise than by my system.

Mr. Gibbins is quite right in saying that the vitriol manufactured under these circumstances is so charged with nitrous acid that, on concentration, a great loss of nitric acid is caused; but, as Mr. P. Spence explains very well, this acid is not employed directly, but is run into a series of different chambers, where it loses so completely all nitric acid, by the action of sulphurous acid, that the vitriol which is run off no longer gives a colouration on addition of sulphate of iron.—I am, &c.,

P. W. HOFMANN.

Société Anonyme des Anciennes Salines
Domaniales de l'Est.
Establissements de Dieuze (Meurthe),
April 4th, 1870.

MAGNETIC PHENOMENA.

To the Editor of the Chemical News.

SIR,—Having recently met with some curious results in the shape of magnetic phenomena, I take the liberty of transmitting you an account of them. Having magnetised an ordinary needle by means of a small horseshoe (1 inch

across at the poles), I floated it on some water, when it arranged itself in the magnetic meridian and exhibited the usual attraction and repulsion to a small bar magnet. The horseshoe was now rubbed to and fro upon the northern half of this bar (which was four inches long, and about the thickness of a lucifer) for several times from position *a*, in which the horseshoe's south occupies the bar's centre, and its north is intermediate between that of the bar and its centre to position *b*, in which the horseshoe's and bar's north are both in contact, as shown in the annexed diagram,

Upon trial it was found that both poles of the bar were now south, attracting the north of the floating needle and repelling its south. A repetition of the experiment on the southern half of a similar bar resulted in two north poles. Another magnetic bar being then obtained, the horseshoe was left in position (*b*) for ten seconds,

when the extremity, which had been thus exposed, was found to repulse the needle's south when presented to it within the space of one-eighth of an inch, and to attract its north when placed in like proximity to it, but, beyond this distance, the reverse phenomena was exhibited the same as before exposure. After exposing in the same way for another ten seconds, the equilibrial points were found to have become situated farther from the needle's extremities, and other repetitions gradually removed them to the distance of half an inch, the south of the floater then always retiring to that distance from the bar's affected extremity or approaching thereto, according as the bar was presented within or beyond it; whilst the floater's north acted in manner precisely reverse. The way in which the south followed the bar when moved slowly excited the impression of its being in some manner moored to it.

Still further exposure to the horseshoe did not produce any further change until it was made at a position nearer the bar's centre: thus—

upon which the equilibrial points separated to greater distances, and, at length, had retired further than the bar's magnetism was perceptible, so that its north pole now appeared an ordinary south as in the first of our experiments. The result of that experiment being thus obtained in successive steps.

Further experiment yielded analogous results with the bar's other pole, and it was found that contact with the horseshoe in a reversed position always neutralised the effect of contact in the other.

The following experiment was then made with the floating needle:—

Its north was exposed to the horseshoe's north for a short interval as annexed, but not permitted to approach it nearer than the sixteenth of an inch.

Upon refloating, it was found to have lost some of its directive power (shown by its moving more slowly to the magnetic meridian), and by cautious repetition of similar exposure this power was at length totally destroyed, and a floating needle obtained which remained quiescent in whatever position was given to it, and exhibiting two south poles.

To assist in producing these results it may be observed that should the horseshoe's north be applied too long to the needle's extremity, this extremity will become more powerfully south than the other, in which case the needle will not fail to arrange itself as usual. This, however, may be counteracted by a momentary exposure to the horseshoe's south, so that the experimenter will be enabled to bring about the conditions sought in all cases very readily by such alternation.

In conclusion, it may be remarked, that needles with similar poles at both extremities always exhibit the opposite magnetism somewhere within their length, and that the double poled results appear to be permanent.—I am, &c.,

EDWARD PORTER, jun.

478, Crown Street, Sydney.

PS. I enclose a needle, which was prepared in January, 1869, exhibiting two south poles, as may be proved by floating it and applying a magnetised bar near either extremity, when either will be found to recede from a south and approach a north pole. Care must be taken to prevent the needle's *contact* with any magnet lest its properties be altered.

MISCELLANEOUS.

Female Students of Chemistry.—Yesterday, at the Chemistry Class in the University, the results of the examinations held in the course of the session were announced by Professor Crum Brown, who stated that 13 of the students had attained first-class honours. Their numbers stood as follows:—87, 86, 85, 84, 82, 81, 80, 80, 78, 76, 75, 75, 75. The third name on this list is that of Miss Mary Edith Pechey (85); the tenth that of Miss Sophia Jex Blake (76)—two of the six lady students who, in accordance with the decision of the University authorities at the beginning of the session, had been admitted to study in the medical classes. To the four students whose names stand highest in the Chemistry Class for the session the Hope scholarships fall to be awarded, two of which entitle the holder to attend at the laboratory for the winter and summer sessions, and two for six months only. Dr. Crum Brown, however, announced yesterday that the scholarships would be given, not to the four students highest on the list, but to Messrs. (1) Wilson (2) Alston, (4) Young, and (5) M'Queen—Miss Pechey's name, which stood third, being thus dropped out, though it was at the same time announced that Miss Pechey was entitled to, and would receive, one of five medals awarded to the five highest students of the session. This decision, which is not, we understand, likely to pass unchallenged, seems the more ungracious when the origin of the scholarships—of what seems her clear right to one of which Miss Pechey has thus been arbitrarily deprived—is considered. They arose out of the success of a course of lectures given a number of years ago by Dr. Hope, then Professor of Chemistry, to a ladies' class held in the University. Dr. Hope was so much gratified by the popularity of these lectures that, with their proceeds (amounting to about £1000), he founded the scholarships in question. It is rather remarkable that, on the first occasion on which ladies have had the chance of competing for these scholarships, one of them should have triumphantly entitled herself, by her position in the class, to this honour and reward—still more remarkable, surely, that she should not receive it. The facts as to Miss Pechey's eminence are even stronger than they appear as stated above; for we understand that both the gentlemen whose names precede hers had attended a previous course of chemistry. So that Miss Pechey's position is absolutely the highest of all the students who may be classed as students of the year, the whole number of the class being about 236, inclusive of the six ladies.—*The Scotsman*, March 29th.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, March 28, 1870.

This number contains the following papers relating to chemistry and physical sciences:—

Application of an Electric Current in Calorimetry.—J. Jamin. this paper is divided into the following sections:—Application in the case of solids and liquids; gases and vapours; latent heat; the two specific heats.

Specific Heat of Water between 0° and 100°.—J. Jamin and A. Amaury.—An algebraico-physical paper, containing a very large number of tabulated results, in figures. There is annexed to this paper another, by V. Regnault, containing a series of observations and remarks on the contents of the essay of the authors.

On Trichlorhydrine and Substances Isomeric therewith.—J. Berthelot.—The chief leading points of this lengthy paper are that hitherto no trichlorhydrine has been prepared, except by the aid of substances derived from glycerine. There exist, moreover, at the very least, five bodies isomeric with trichlorhydrine, viz.:—(1) The chlorinated derivatives from the hydride of propylen, C_6H_8, including, in all probability, those of the normal propyl-chlorhydric ether; (2) the derivatives from the chlorhydrate of propylen, $C_6H_8.HCl$, or the iso-propyl-chlorhydric ether; (3) the derivatives from the normal chloride of propylen, $C_6H_8.Cl_2$, corresponding to the chloride of ethylen and diatomic alcohol; (4) the derivatives from dichlorhydric aceton; (5) the derivatives from trichlorhydrine, $C_6H_8.Cl_2$, corresponding to glycerine —that is to say, a normal triatomic alcohol.

Supersaturation of Chloride of Calcium.—E. Lefebvre.—This paper is an excellent contribution to the study of the phenomena presented by some saline solutions under various circumstances. The author first alludes to the well-known phenomenon presented by solutions of sulphate of soda, under certain conditions, which crystallise instantaneously. Solutions of chloride of calcium, and of the chlorides of strontium and barium, exhibit, if properly concentrated, the same sudden crystallisation; and the contents of this paper record the results of the author's extensive researches on this subject.

Chemical Research on Eucalyptol.—S. Cloëz.—The tree known by the name of *Eucalyptus globulus*, a native of Tasmania (where this species was discovered, in 1792, by M. Labillardière) has been successfully acclimatised in the southern parts of France and other parts of Southern Europe. The author has discovered, in the leaves of that tree, a substance which he has named eucalyptol, a liquid specifically lighter than water, viz.—0·905 at 8°. Eucalyptol is difficultly soluble in water, but easily soluble in alcohol; this solution, when very dilute, has an odour analogous to that of roses. The formula of this substance is $C_{24}H_{20}O_2$; its vapour density, 6·22. Treated with anhydrous phosphoric acid, eucalyptol yields eucalypten, $C_{24}H_{18}$. The quantity of eucalyptol contained in the leaves of this tree, which, by-the-bye, is, like the other eucalyptus species, remarkable on account of growing to heights of 80 and 100 metres, varies from 2·75 to 6 per cent.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869 (continued).

Contribution to the Knowledge of the so-called Nitrate of Iron of Commerce.—E. Lenssen.—Under the above name, there is met with in commerce an oily fluid of a blackish brown colour, and generally as heavy as 50° Baumé (1·525 sp. gr.); it tastes rather astringent, while it gives off a smell of nitrous acid; it is used very largely in dyeing and printing. The author has analysed several different samples of this material and gives the following three analyses as instances of what is sold (on the Continent) for nitrate of iron. Sample marked N contained, in 100 parts—Peroxide of iron, 18·8; protoxide of iron, 0·4; sulphuric acid, 23·3; hydrochloric acid, 0·9; water, 56·6 = when formulated and in percentages—Fe_2Cl_3, 1·3; FeO,SO_3, 0·8; $Fe_2O_3,3SO_3$, 22·9; $Fe_2O_3,2SO_3$, 18·2; water, 56·8. Sample marked L contained, in 100 parts—Peroxide of iron, 20·10; sulphuric acid, 19·74; hydrochloric acid, 3·96; nitric acid, 2·18; water, 54·02 = formulated and percentically—Fe_2Cl_3, 5·86; $Fe_2O_3,3NO_4$, 3·25; $Fe_2O_3,3SO_3$, 17·95; $Fe_2O_3,2SO_3$, 17·94; HO, 55·0. Sample marked T—Peroxide of iron, 18·04; sulphuric acid, 21·69; hydrochloric acid, 1·68; nitric acid, 1·12; water, 54·47 = Fe_2Cl_3, 2·50; $Fe_2O_3,3NO_5$, 1·67; $Fe_2O_3,3SO_3$, 27·15; $Fe_2O_3,2SO_3$, 10·80; water, 57·88. The sp. gr. of all these samples was exactly 1·525. This lengthy paper contains, further, very valuable information on the use, the best mode of manufacture, and the best methods of analysis and practical assay of this material, which is especially used to increase the weight of silk when that material is to be dyed black or blue of certain shades.

Methods of Research in Water Statistics.—Dr. H. Trommsdorff.—Under this title, the author gives a treatise on water analysis, divided into the following sections:—Hydrotimetry, description of the apparatus for measuring and preparation of the titrated soap solution; estimation of total hardness; estimation of the carbonate and sulphate of lime, of the magnesia salts, and of the free carbonic acid; estimation of the permanent hardness; estimation of the magnesia salts; description of the hydrometrical method of the estimation of the total sulphates; estimation of chlorine; estimation of organic substances; general preliminaries; preparation of volumetrical solutions; description of the application of these solutions; estimation of ammonia; colorimetrical estimation of ammonia; preparation of Nessler's test, and of a standard solution of chloride of ammonium; estimation of nitrous acid; estimation of nitric acid.

Precipitation and Estimation of Manganese by Hydrosulphuret of Ammonium.—Dr. A. Classen.—This paper is a lengthy series of tabulated results of volumetrical experiments made under the following headings:—Behaviour of mono-hydrosulphuret of ammonium with a solution of manganese in the presence of chloride of ammonium; behaviour of poly-hydrosulphuret of ammonium with a precisely similar solution; behaviour of mono-hydrosulphuret of ammonium containing free ammonia with a precisely similar solution of manganese; behaviour of poly-hydrosulphuret of ammonium containing free ammonia with a solution of manganese containing chloride of ammonium; behaviour of mono-hydrosulphuret of ammonium with a solution of manganese containing variable quantities of chloride of ammonium and free ammonia; behaviour of poly-hydrosulphuret of ammonium with manganese solutions as foregoing.

Utilisation of the Liquids containing Molybdic Acid from the Residues of Phosphoric Acid Estimation.—Dr. F. Muck.—The acid liquors, the filtrates from the yellow precipitate, are mixed with the ammoniacal wash-waters from the ammonio-phosphate of magnesia precipitates, and, in addition, there is added phosphate of soda solution, in the proportion of 1 part of phosphoric acid to 30 of molybdic acid; after which, the fluid is left at rest for twenty-four hours in a warm place. The precipitate is collected on a filter and washed, until the filtrate begins to run slightly turbid; the precipitate is next dried in a water-bath, and next dissolved in ammonia (360 parts to 100 of precipitate), and this solution is poured into nitric acid (1350 parts) into which, previously, from 2 to 3 parts of pure magnesia have been dissolved. The ensuing precipitate of ammoniacal phosphate of magnesia is next removed; and, after having been standing for some time, in order to give time for a small quantity of phosphate of molybdenum to settle down, the solution is fit for use again as molybdate of ammonia.

Concentrated Sulphuric Acid, a Test for Molybdic Acid.—Dr. Schönn.—When molybdic acid, or the ammonia, soda, lead, or baryta salts of that acid are heated in a porcelain capsule, with just sufficient sulphuric acid to moisten the material, of which only a few small bits (less than two milligrms.) suffice for the experiment, there will be observed the appearance of a blue, ultramarine-like colouration, which disappears again when the sulphuric acid is evaporated. When quantities of 10 milligrms. and upwards are acted upon, the blue colour is evidenced, even at the ordinary temperature, but it is best to add a few drops of alcohol. A solution of molybdic acid has to be first evaporated to dryness, and the native sulphide of molybdenum must be first converted into molybdic acid, before this most sensitive test can be applied; neither titanic, tungstic, or vanadic acid exhibit this phenomenon when similarly treated with sulphuric acid.

Fusion of Substances with Sodium or Potassium.—Dr. Schönn.—A lengthy paper on some methods of fusion and ignition whereby sodium (being the cheapest) is applied to disintegrate and decompose, at a high temperature, various substances. We regret that the paper is not suited for useful abstraction.

Estimation of Uranium.—Dr. C. Winkler.—The author reviews and criticises Patera's labours on this subject, and chiefly points out some mistakes made in his calculations, as published in a former volume of this periodical.

Direct Estimation of Valerianic Acid in Valerianates.—A. Zavatti and F. Sestini.—Since the method of quantitative estimation here proposed and described is acknowledged and admitted by the authors to be invariably attended with a loss of at least 6 per cent of the substance to be estimated, we need not enter into details on this subject.

Phenylate of Potassa as a Test for the Presence of Water in Ether.—J. Romei.—Perfectly dry phenylate of potassa is quite insoluble in anhydrous ether, but partly dissolves in that liquid when containing water, and then imparts to it a reddish brown colour. The author found that, even when the ether contains only 2·5 parts of water in 1000 of ether, the test is perfectly perceptible.

Reduction of Small Weights.—Dr. K. L. Bauer.—An algebraical essay.

Composition of Atmospheric Air at Various Heights.—Dr. K. L. Bauer.—This paper contains a series of cypher figures derived from a formula (algebraic) as given by V. Regnault.

Behaviour of Sodium and Magnesium with Substances, and especially Liquids, which contain Sulphur.—Dr. Schönn.—After briefly referring to a former paper on this subject, the author now states that, instead of sodium, pulverised magnesium can be used for the detection of sulphur, in the following manner:—The substances to be tested (for instance, the sulphates of lime or baryta) are thoroughly mixed, previously reduced to powder, and next heated to redness with the metal in a test-tube made of thin hard glass. After the reaction is over, the contents of the tube are, when quite cold, treated with distilled water and tested with nitro-prusside of sodium; organic substances—*e.g.*, previously-carbonised albumen—may be tested in the

same manner for sulphur. As regards liquids containing sulphur, the author states that a drop of sulphuric acid, when brought into contact with sodium, yields, among the products of the reaction, sulphuret of sodium; with magnesium, this reaction does not take place unless heat be applied. Sulphide of carbon and essential oil of mustard may be readily proved to contain sulphur by application of the same test.

Very Simply-Constructed Small Sulphuretted Hydrogen Gas Apparatus.—G. Hinrichs.—Illustrated with a woodcut essentially necessary for the proper understanding of the description.

Quantitative Estimation of Carbon in Pig-Iron.—Dr. R. Fresenius.—The weighed quantity of iron to be tested for carbon is placed on a small porcelain boat and introduced into a hard glass combustion-tube, placed in a combustion-furnace, and, when red-hot, a current of dry chlorine gas (dried by making it pass over pieces of pumice-stone moistened with strong sulphuric acid) is passed over; the current of gas and application of a low red heat is continued until all the iron is volatilised as chloride. The carbon left in the small boat is, after the apparatus has cooled, placed in a porcelain tube and burned. After being heated to redness in a current of oxygen, the products of the composition are taken up by Liebig's potash-bulbs. Great care is required that the chlorine be thoroughly dry, since, otherwise, hydrocarbons may be formed and some carbon lost.

Behaviour of the Vapours of Nitrous and Hyponitric Acid when Daylight passes through them.—Dr. E. Luck.—This paper contains a series of observations on the spectra exhibited by these substances.

Absorption-Spectrum of Perchloride of Manganese (Mn_3Cl_7). Dr. E. Luck.

Behaviour of Hypochloric Acid with Brucine and its Salts, and on the Value of the Reaction of Brucine for Detecting Small Quantities of Nitric Acid.—Dr. E. Luck.—The main point of interest of this paper is the fact that, when brucine comes into contact with hypochloric acid and free sulphuric acid, there appears a highly-red colouration, which disappears on the addition of tin-salt. The use of brucine for the detection of nitric acid is, according to the author's researches, not very reliable, and less distinct than the reaction of phenol-sulphuric acid with nitric acid.

Solubility of Cream of Tartar (Bitartrate of Potassa) in Aqueous and Alcoholic Fluids; Testing of the Berthelot Fleurien Method for the Quantitative Estimation of that Salt, and of Tartaric Acid, in Wine.—E. Kissel.—This lengthy paper, and the following—

Estimation of Acetic Acid in Wine—E. Kissel—Are too extensive for useful abstraction, and, moreover, chiefly interesting in vine-growing and wine-producing countries.

Composition of the Carbonates of Manganese.—E. Prior.—The author describes, at very great length, a series of experiments in order to elucidate the real composition of carbonate of manganese, prepared in different ways and with pure materials, and with precautions as regards its alteration by oxidation. The precipitate produced in a solution of pure and neutral sulphate of manganese by the addition of carbonate of ammonia is, after very careful drying *in vacuum*, composed, in 100 parts, of—MnO, 57·25; CO_2, 35·48; HO, 7·27. Formula, $2(MnO,CO_2)+HO$. The precipitate produced by carbonate of soda in solutions of salts of protoxide of manganese is composed, in 100 parts, of—MnO, 61·73; CO_2, 38·27. The precipitate, however, of carbonate of manganese, as usually obtained by precipitating a proto-salt of that metal with carbonate of soda, was found to consist, after drying at 60°, in 100 parts, of—MnO, 62·11; CO_2, 37·89.

Action of Boiling Saline and other Solutions upon Vessels of Glass and Porcelain.—W. Casselman.—This very lengthy paper contains the results of an extensive series of experiments, from which the following general results are derived:—Water and acids hardly, if at all, act upon good porcelain vessels; the fixed alkalies attack porcelain, but less so than they do glass, which is far more readily and generally acted upon by the substances alluded to, as well as by saline solutions.

Journal de Pharmacie et de Chimie, March, 1870.

This number contains the following original papers and memoirs:—

Two Products of the Boletus Laricis (a kind of Mushroom).—G. Fleury.—The author has separated from this, previously dried and pulverised, cryptogamic plant, a resinous substance, insoluble in water; soluble in ether, absolute alcohol, chloroform, and acetic acid; insoluble in benzol and sulphide of carbon; and fusing at 89·7°. Caustic potassa solution and ammonia take up this body, yielding solutions which froth very strongly. This resin consists, in 100 parts, of—Carbon, 71·6; hydrogen, 9·6; oxygen, 18·8; its barium compound is $C_{31}H_{48}BaO_{11}$. Agaricic acid, a white crystalline body, fusing at 145°, soluble in alcohol, but hardly soluble in water or ether. Percentage composition—Carbon, 64·0; hydrogen, 9·3; oxygen, 26·7.

Preparation and Properties of Hydrate of Chloral.—J. Personne, and—

Report on some Facts relating to the History of the Hydrate of Chloral—MM. Roucher, Lebaigue, and Jungfleisch—Are, although valuable, strictly pharmaceutical papers.

Search for Cyanhydric Acid in Tobacco Smoke.—Drs. Poggiale and Marty.—Since Dr. Vogel, in Germany, had stated that he had very readily detected cyanhydric acid in tobacco smoke, by means of Schoenbein's test-paper for that acid, the authors have very carefully conducted a series of experiments, by means of aspirators, with tobacco (200 grms. at a time) placed in the bowl of a large pipe, and have tested the smoke, as well as the tarry and oily products of the combustion of tobacco, with the following results:—Tobacco smoke does not contain any hydrocyanic acid; neither is any found in the other (condensed) products of the combustion of tobacco. The authors also state that Schoenbein's prepared paper for the detection of cyanhydric acid is not reliable for that purpose; while they have applied proper tests, and compared these with fluids to which either cyanhydric acid or cyanides had been purposely added.

Les Mondes, March 31, 1870.

Decrease of the Temperature of the Air in relation to the Elevation Above Sea Level.—Dr. Hann.—This author has tried to solve, experimentally, or, rather, by observation, the problem of the decrease alluded to by comparing the average of temperature, as observed at certain groups of stations situated under the same mean latitude and longitude, and by taking into account local influences. Seven of these groups are situated in the western portion of the Alps, at from 230 to 3330 metres above sea level; four in the northern part of Switzerland, at from 500 to 1780 metres above sea level; three in the Rauhe Alps (Wurtemberg), at from 310 to to 810 metres above sea level; four in the Ezgebirge (Central Germany), at from 180 to 850 metres above sea level; and four in the Harz (province of Hanover and Brunswick), at from 70 to 1140 metres above sea level. The results obtained have proved that, in the instances mentioned, the decrease of the temperature of the atmosphere near to the ground is really proportionate to the height of the locality above sea level. When the results of all the observations are duly considered, there is discovered to exist a very strongly-marked annual periodicity, and a very uniform decrease of temperature from below to above, the average relation of the temperature reigning in December being, to that of June, as 1 to 2.

Bayerisches Industrie und Gewerbe Blatt, January and February, 1870.

These numbers contain, as usual, the full texts of a great number of official communications, chiefly of local importance, and, in addition thereto, the following papers relating to chemistry and collateral sciences:—

Supply and Quality of the Water Used for Domestic Purposes to the City of Munich.—Dr. A. Wagner.—It appears, from this paper, that the capital of Bavaria is exceedingly well off, both as regards the sources of supply, the quantity and quality of the water, which is very pure, containing, as it does, only from 0·16 to 0·60 grms. of solid matter (organic inclusive) to the litre of fluid.

Substitute for Copper for the Daniell Electric Battery.—Dr. C. Stölzel.—The author says—Take a piece of well-polished tin-plate (sheet tin, not tinned iron), immerse it in a very dilute solution of a copper salt, and put it in connection with a weak galvanic current. After the lapse of from fifteen to eighteen hours, a layer of strongly-adhering metallic copper will have become firmly deposited upon the tin-plate; and the latter, after having been bent into the required shape, is an excellent, cheap, and durable substitute for the copper cylinder in Daniell's battery.

Collieries near Miesbach, Upper Bavaria.—F. Hailer.—An excellent monograph, from which it appears that, as far back as the year 1447, pit-coal was known, and in use (limited, however), in that district.

Albolith.—W. Riemann.—Under this name, the author prepares a cement chiefly consisting of magnesia. For this purpose, the magnesite of Frankenstein (Silesia) is ignited in retorts similar to those used for gas manufacture; and, after the mineral (a native carbonate of magnesia) has been ignited, it is mixed with silica and some other substances not specified. This mixture has the property of yielding, with moderately-concentrated solutions of chlorides (for instance, chloride of magnesium), a most extremely plastic, but, on drying, a very hard material, excellently adapted for use as cement for stucco and ornamental work, and instead of gypsum.

These numbers also contain the programme of a General Industrial Exhibition intended to be opened at Cassel (Prussia) in June next. The object of this Exhibition is very similar to that held at Amsterdam last year.

Journal für Gasbeleuchtung, February, 1870.

This number contains—

Regulations for the Inspection and Testing of Gas Meters for the Grand Dukedom of Oldenburg.

Collection of Facts relating to the Supply of Potable Water for Altenburg, Berlin, Zürich, and a large number of Cities and Towns of Germany, Austria, Hungary, and Northern Italy.

Polytechnisches Journal von Dingler, first number for February, 1870.

The number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Thermometer and Pyrometer Provided with Automatical Electric Signalling Apparatus.—O. Zabel.—This paper is illus-

trated with a series of engravings, absolutely required for the proper understanding of the useful contrivances herein described.

Combined Areometer.—Dr. H. Bardeleben.—This lengthy memoir, also illustrated with an engraving, describes an instrument—an ingenious combination of the scale and the weight areometer—whereby the determination of the specific gravities of solid bodies is rendered easily performed, while the instrument serves, at the same time, the purposes of the areometers in ordinary use.

Application of Gas to Blast Furnaces.—F. Lürmann.

On Rapakiwi as a Suitable Material of the Manufacture of Bottle-Glass.—H. G. Benrath.—The material known in Finnland (a portion of the Russian Empire) as rapakiwi, and wrought in the quarries of Pyterlak, consists, in 100 parts, of—Silica, 74·24; alumina, 12·13; peroxide of iron, 2·88; lime, 0·90; magnesia, 0·19; potassa, 6·68; soda, 2·50; water, 0·04. The author describes, further in his paper, a series of experiments made with the view to ascertain the most suitable materials, and the quantities thereof, to be mixed with the mineral (a kind of granite used for building and ornamental purposes, especially in St. Petersburgh) in order to form good glass.

Utilisation of Exhausted and Sliced-Up Beet-Roots as Fodder.—Dr. C. O. Tech.—This paper is chiefly interesting to beet-root sugar makers who apply the so-called Robert's method of juice extraction.

Second February number.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Improved Pyrometer.—C. Bock.—To this paper, and the following—

Control Thermometer—Th. Oechelle—The engravings are required for the proper understanding of the subjects described.

Changes and Alterations Coal Undergoes by Exposure to Air.—Dr. E. Richters.—We can only quote the titles of the different sections this highly-interesting paper has been divided into, viz.:—Chemical process of the oxidation of coals; influence of heat on the process of oxidation; influence of moisture upon the oxidation; influence of light upon this process.

Possibility of the Application of Gas to Blast Furnaces.—C. Schinz.

Bleaching of Wool.—Dr. H. Grothe.

Activity (Wirksamkeit) of Amorphous Phosphorus for Safety Matches.—W. Zettel.—A paper of special interest only to lucifer match makers.

Schlickeysen's System of Improving Peat.—R. Schmidt.

Coating of Brass with Bismuth.—C. Puscher.—Add, to a solution of nitrate of bismuth, made with 16·66 grms. of that metal, 33·32 grms. grms. of purified cream of tartar dissolved in boiling water, and add from 50 to about 67 grms. of previously-pulverised bismuth. Place the brass objects to be coated over into this fluid while boiling, and, in a short time, a brilliant silvery white strongly and firmly-adhesive coating of bismuth will be deposited.

NOTES AND QUERIES.

Glycerine.—"Subscriber" is referred to pages 71 and 167 of our 19th volume.

Volatilising Common Salt.—(Reply to "Enquirer.")—Common salt is readily volatilised in the presence of aqueous vapours, and is by no means a non-volatile substance, even at temperatures short of red heat.

Barwood-Red and Indigo-Blue.—Perhaps some of your numerous correspondents would favour me with the best modes of producing the above on cotton cloth, both as regards brilliancy of colour and economical production.—Chemicus.

Dr. Schiebler's Apparatus.—If W. R. will refer to the new edition of Fresenius's "Quantitative Analysis," under "Carbonic Acid Estimation" he will find a description and figure occupying three pages.—A. V.

Detection of Linseed Oil in Rape Oil.—(Reply to B. Ludlow.)—See Chemical News, vol xix., pp. 238 and 252. There does not exist, as far as we have been able to ascertain a special work on oils, either in the English or any other language.

Native Crystalline Phosphates.—Apatite occurs, in the crystalline state in various forms, and so do other phosphates; and therefore the statement made by Mr. Hutton, in reference to the Canadian phosphate, should be taken in a less decided and exclusive manner. Any work on mineralogy will prove the existence of a variety of native crystalline phosphates.—T. A.

Dinitrobenzol.—(Reply to W. H. W.)—There is no doubt that the methods for preparing this compound as described by Dr. Miller and Dr. Watts, are as good as any; if you desire others, you should peruse such periodicals as the *Bulletin de la Société Chimique de Paris*, the *Annalen der Chemie und Pharmacie*, and the *Zeitschrift für Chemie von Beilstein*, all of which you may inspect at the Library of the Commissioners of Patents.

Hardness of Water.—(Reply to W. R.)—A water of 15 and 4-10ths degrees would require 31 measures of soap, but if diluted to twice its volume, it would require 34 measures of soap. Take another instance: the standard water, if diluted to twice its volume, would require 35 measures of soap. The extra quantity of soap used, after diluting, represents the hardness of the pure water added. Selenite is preferable to calcium chloride for the standard water, as it requires no preparation; when finely powdered, it readily dissolves. A useful table will be found in the new edition of Fresenius's "Quantitative Analysis," which is an expansion of Clark's, and saves all trouble of calculation; it gives the soap-test required from 0° to 16°, at intervals of 1-10th degree.

MEETINGS FOR THE WEEK.

Monday, April 11th.—Medical, 8.
—— London Institution, 4.
—— Geographical, 8.30.
Tuesday, 12th.—Photographic, 8.
—— Institution of Civil Engineers, 8.
—— Ethnological, 8.
Wednesday, 13th.—Geological, 8.
—— Microscopical, 8.
Thursday, 14th.—London Institution, 7.30.
Saturday, 16th.—Quekett Microscopical Club. Excursion to Barnes. To meet at Waterloo Station (Richmond line), at 2 p.m.

CHEMISTRY CHAIR IN ANDERSON'S UNIVERSITY.

To the Trustees and Managers.

Gentlemen,—As a Professor to fill the present vacant Chair of Chemistry in Anderson's University is likely soon to be appointed, and as it is my intention to become a Candidate, I take the liberty of addressing a few statements to you as preliminary to sending in testimonials, &c.

I at present hold the appointments of Lecturer on Chemistry to the Glasgow Mechanics' Institution and Professor of Chemistry in the Glasgow Veterinary College. The former I received upwards of four years ago, when five candidates came forward; and the latter appointment I obtained, also four years ago, on the recommendation of the late Professor Penny, who was for many years chemical teacher in both institutions—and on his resignation of the Professorship in the Veterinary College, it was mainly through him that I was appointed in his place.

About five years ago, the Faculty of Physicians and Surgeons of this city deputed two of its members to report on my Chemical capabilities; and the result was a grant from that body recognising my lectures and practical classes as qualifying for examination before their board, and all other boards, &c., which recognise the Chemical teacher's certificates of Anderson's University.

I received my Chemical training in Edinburgh College of Surgeons, under Dr. Macadam, where I remained upwards of seven years. During much of that time I was Senior Assistant and Demonstrator, and had charge of large classes of both medical and manufacturing students. The analyses of medical and technical products were made daily by me in Dr. Macadam's laboratory.

On my coming to Glasgow to open a laboratory of my own, which I did in Ingram Street, I found the field of work extensive enough, but so well taken up by other Chemists that little could be accomplished for a year. My appointments to the Mechanics' Institution and Veterinary College, as Chemical teacher, opened a road; and by no small amount of energy and perseverance I have now the satisfaction of possessing the largest Practical Chemistry Classes in the city.

I have lectured daily, and held practical classes, in my laboratory and lecture-rooms and out of them, for five years, since I came to Glasgow. As you are already aware, I have expended large sums of money in fitting up my laboratories, &c., with apparatus suitable to the advancement of classes in Technical Chemistry.

The number of medical students who have attended my lectures and classes has been considerable, and at the present time at the Practical Medical Class there are twenty-one students. This number, when it is remembered the disadvantages the additional teacher must be under, who is some distance from the Andersonian, is highly gratifying.

It is out of place at this time to refer to personal scientific researches and discoveries; but, as indicating that I have not been backward in adding to Chemical facts, I may mention Oleography, Water Analysis, Free Sulphuric Acid, Manure Analysis, Detection of Strychnine, Blood Stains, Wood Paper, as some amongst my original investigations.

The departments of Scientific, Medical, and Technical Chemistry occupy my entire attention, and perhaps the best evidence of work done satisfactorily is in the fact of having enrolled, during three sessions, upwards of 500 practical students, and these at fees considerably higher than at any laboratory in the city; while the number of lecture students was 313. These numbers chiefly represent manufacturing students.

Should I have the honour to be elected by you, I shall endeavour to hold the appointment with acceptance.

I beg to place before you these statements, and I shall consider it a great favour to have your support at the time of the appointment.

I am, Gentlemen, yours respectfully,

R. CARTER MOFFAT, Ph.D.

Analytical Laboratory, and School of Technical and Medical Chemistry,
Mechanics' Institution, 38, Bath Street, Glasgow.

THE CHEMICAL NEWS.

VOL. XXI. No. 542.

ON THE

RELATION BETWEEN THE SUN'S ALTITUDE AND THE CHEMICAL INTENSITY OF TOTAL DAYLIGHT IN A CLOUDLESS SKY.*

By HENRY E. ROSCOE, F.R.S., &c., and T. E. THORPE, Ph.D., &c.

IN this communication, the authors give the results of a series of determinations of the chemical intensity of total daylight, made in the autumn of 1867, on the flat plateau of the River Tagus, about 8½ miles S. E. of Lisbon, under a cloudless sky, with the object of ascertaining the relation existing between the solar altitude and the chemical intensity of the light.

The experiments were made as follows:—1. The chemical action of total daylight was observed in the ordinary manner; 2. The chemical action of the diffused daylight was then observed, by throwing on to the exposed paper the shadow of a small, blackened brass ball, placed at such a distance that its apparent diameter, seen from the position of the paper, was slightly larger than that of the sun's disk; 3. Observation No. 1 repeated; 4. Observation No. 2 repeated. Next, the means of observations 1 to 4 were taken. The sun's altitude was determined by a sextant and artificial horizon. One of the sets of 134 observations was made as nearly as possible every hour.

It has been already pointed out, and proved by experiments made at Kew, that the mean chemical intensity of total daylight, for the hours equidistant from noon, is constant. The results of the present series of experiments prove that this conclusion holds good generally. One of the chief results arrived at is that, although the chemical intensity for the same altitude, at different places and at different times of the year, varies according to the varying transparency of the atmosphere, yet the relation, at the same place, between altitude and intensity is always represented by a straight line.

ON THE ACIDS CONTAINED IN CRAB OIL.†

By WILLIAM J. WONFOR,
Student in the Laboratory of the Goverment School of Science, Dublin.

CRAB oil is obtained from the nuts of a tree known botanically as *Hylocarpus carapa*, and also as *Carapa Guianensis*. This tree grows abundantly in the forests of British (also of Netherland's) Guiana. The oil is prepared from the kernels, by boiling them for some time in water, and then placing them in heaps, and leaving them for some days. They are next skinned, and afterwards triturated in wooden mortars, until reduced to a paste, which is spread out on inclined boards, and exposed to the sun: the oil is thus melted out, and trickles into receiving vessels.

The author obtained the oil as met with in the country it is prepared in, by native Indians, and hence by rather primitive and unskilful methods. It is a semi-fluid, butyraceous mass, evolving a penetrating odour. The oil melts at 55°. In order to obtain the acids, the oil was saponified with a solution of potassic hydrate, and the soap obtained dissolved in a large quantity of water, to which solution of sodic chloride was added in excess. The soap thus separated was washed, and again dissolved in water, and that solution decomposed by means of hydrochloric acid. The liberated fatty acids were collected and pressed, and, after having been carefully freed from any sodic chloride, again saponified, and the same treatment repeated; and the soda-soap obtained decomposed with tartaric acid. The melting-point of the mixed acids was 40°.

The author describes, further, at great length, the purification of the acid, and states that its melting-point is 57°.

The acid presents the appearance of a white, glistening mass, which, on being submitted to organic elementary analysis, gave, in 100 parts:—Carbon, 75·00; hydrogen, 12·50; oxygen, 12·50. Formula, $C_{16}H_{32}O_2$. The composition of the argentic palmitate is, $C_{16}H_{31}O_2Ag$.

The author also prepared the ethylic palmitate, $C_{16}H_{31}(C_2H_5)O_2$, and also describes a baric salt. He further states that, for various reasons, he was, to his regret, not enabled to examine quite satisfactorily the acid of the lower melting-point contained in the original saponified and purified mass.

ON THE

CHEMICAL EQUILIBRIUM BETWEEN CARBON, HYDROGEN, AND OXYGEN.

By M. BERTHELOT.

THE following facts are the result of experiments on decomposition of carbonic acid, steam, and the prolonged reaction of the spark on sundry mixtures of hydrogen, oxide of carbon, oxygen, steam, and carbonic acid.

1. *Decomposition of Carbonic Acid.*—This gas, when traversed by a series of induction-sparks, decomposes rapidly. The decomposition reaches a certain limit, then retrogrades, again augments, diminishes, and so on, without tending towards any fixed limit. This is shown by the following table, which demonstrates the volume of gases non-absorbable by potash (oxide of carbon, and oxygen) contained in 100 volumes of the mixture under analysis. The experiment was conducted with 200 c.c. of gas, the sparks, which were strong and slow, proceeding from a Ruhmkorff coil fed by six elements of Bunsen. The specimens were taken and analysed from time to time.

After 5 minutes	..	13·0	After 99 minutes	..	7·0
12 ,,	..	10·0	110 ,,	..	6·0
14 ,,	..	9·5	128 ,,	..	6·0
24 ,,	..	7·5	143 ,,	..	5·0
39 ,,	..	5·5	153 ,,	..	7·0
54 ,,	..	10·0	163 ,,	..	10·0
84 ,,	..	12·5			

The relation 2 – 1 between the oxide of carbon and the oxygen was verified every time; it exists only when the spark plays between platinum wires placed at a great distance from the mercury, otherwise part of the oxygen is absorbed by the latter. All this tends to establish the important fact that the decomposition of carbonic acid does not tend towards any fixed limit; this is contrary to what occurs during the decomposition of acetylene and many other reactions. This absence of a fixed limit indicates the simultaneous existence of two contrary but independent causes. Of this more anon.

2. The extreme limits between which the decomposition oscillates have no elements of constancy; all depends on the length and intensity of the sparks, as a comparison of the preceding table with the following will show.

* Abstract of a paper communicated to the Royal Society.
† Abstract of a paper read before the Royal Society. Communicated by Dr. Maxwell Simpson.

	Short sparks.	Very short and feeble sparks.*
After 10 minutes.. ..	14·0	—
„ 15 „	—	6·0
„ 25 „	18·0	—
„ 37 „	19·0	13·5
„ 60 „	1·5	29·0
„ 82 „	24·0	2·0

* Two elements of Bunsen.

These figures show progressive decomposition followed by re-combination.

3. A mixture of 2 volumes of oxide of carbon and 1 volume of oxygen, with a suitable quantity of carbonic acid, does not explode. It is only necessary that the carbonic acid should constitute 60 or 65 hundredths of the entire volume. The limit is still somewhat uncertain, according to the intensity of the sparks. The re-united oxide of carbon and oxygen form, in this instance, from 35 to 40 hundredths of the entire mass.

My next researches related to the limits of the composition of explosive mixtures formed of oxide of carbon and oxygen.

4. I first of all verified the observations of Dalton, according to whom explosion does not occur in the mixture of the two gases containing less than the fifth, or more than the 14-15ths of its volume of oxide of carbon. These limits vary slightly with the intensity of the spark; moreover, in the same mixture, the combustion is sometimes complete and sometimes incomplete. For instance, a mixture formed of—

Oxide of carbon	18·6
Oxygen	81·4

burnt with flame, all the oxide of carbon being changed into carbonic acid in one experiment; while, in another, only 10·0 of it was formed. The result was similar in limited mixtures in which oxide of carbon predominated, or even oxide of carbon and oxygen in the presence of excess of carbonic acid. These variations are due to the cooling action of the excess of gas.

5. Can combination be produced below the limit of explosive combustion, and to what extent? It is only known that, at a certain distance within that limit, the combination is explosive and complete, whilst, at a certain distance beyond it, no combination is appreciable under the influence of a single spark.

Now I have perceived that, in all mixtures of oxide of carbon and oxygen beyond the point of explosion, the combination takes place under the influence of a current of prolonged sparks, and that it is completely effected, whatever may be the excess of oxygen or oxide of carbon; for instance, in a mixture formed of—

Oxide of carbon	13·0
Oxygen	87·0

a current of strong sparks, prolonged during a minute, was sufficient to form 6·5 of carbonic acid; in five minutes, this figure was increased to 13·0. The result was the same with sundry mixtures containing 8·0 and 5·0 of oxide of carbon; the same with mixtures in which oxide of carbon predominated, the oxygen being 3·3 and 1·0, only in the case of these latter more time was required to complete the action. These different results furnish the types of a progressive action, which tends to a complete combination under homogeneous systems.

6. In order to establish the fact more fully, I also worked upon the reciprocal systems, which resulted in complete reaction, whatever were the mixtures of carbonic acid and oxygen, or carbonic acid and oxide of carbon, whose composition approximates to that of systems corresponding to the limit of explosive combustion. Such are the following—

Carbonic acid	16·6	Carbonic acid	13·0
Oxygen	83·4	Oxide of carbon ..	87·0

After being subjected to the sparks for one hour, I discovered exactly the same volume of carbonic acid; therefore the presence of a suitable excess of oxygen or oxide of carbon completely hinders decomposition.

7. It is altogether different in cases where oxygen or oxide of carbon are contained in the mixture in only slight proportions; for instance, a mixture consisting of 96·5 of carbonic acid and 3·5 of oxide of carbon, when subjected to a current of sparks for a quarter of an hour, augmented to 5·1, by reason of the formation of 3·4 of oxide of carbon and 1·7 of oxygen.

Mixtures in which carbonic oxide is mingled at once with oxide of carbon and oxygen, in the proportion of 2 volumes of one to 1 of the other, behave in a particular way; they are reciprocal with those which ensue from the decomposition of carbonic acid, and furnish the some results for an equivalent compound. Thus, the carbonic acid forming less than 60-100ths, the combination is complete and explosive, as has been already stated. Below 60-100ths, the combination is partial, always incomplete, and does not tend towards any fixed limit.—*Comptes Rendus*, vol. lxviii., p. 1035.

ON THE

DETERMINATION OF PHOSPHORIC ACID.*

By WILLIAM CARLETON WILLIAMS,
Student in the Laboratory of Owens College.

Of the many methods proposed for the separation of phosphoric acid from the alkaline earths, few are better than the one devised by W. Reissig, founded upon a process originally described by Reynoso. This method, although used in many Germany laboratories, has, strange to say, found but little favour among English chemists. This is probably owing to the somewhat complicated and tedious nature of the operations required. The modifications described in the following communication considerably simplify the process, and may, possibly, lead to its more general adoption.

Reissig's method depends upon the fact that, when metallic tin is added in excess to a solution of the phosphate of the alkaline earths in nitric acid, the stannic acid formed by the oxidation of the metal combines with the phosphoric acid and completely removes it from solution. On filtering, therefore, we at once separate the alkaline earths which remain in solution from the insoluble combination of stannic and phosphoric acids. In order to determine the amount of phosphoric acid contained in the tin oxide, the compound is dissolved in a small quantity of concentrated potash solution, when the two acids dissolve as meta-stannate and phosphate of potassium; the fluid is now saturated with hydrogen sulphide, a small quantity of ammonium pentasulphide added, and, lastly, a slight excess of acetic acid. The tin sulphide is then separated by filtration; all the phosphoric acid is contained in the filtrate, and its amount may be determined by the ordinary method as magnesium ammonium phosphate.

The chief disadvantage of this method arises from the necessity of employing a large excess of metallic tin, in order to completely remove the phosphoric acid from solution. The bulk of tin sulphide obtained is, therefore, very large, and its filtration and washing is an exceedingly long and tedious operation. In order to shorten the process, Reissig recommends that the alkaline solution of the phosphate and stannate be transferred to a weighed flask of 1000 cubic capacity, and then diluted with water until the fluid measures about 900 cubic; the solution is next saturated with hydrogen sulphide, then ammonium sulphide and acetic acid in slight excess added, and the tincture diluted until the whole weighs 1000 grms. After standing for a few hours the clear supernatant liquid is carefully poured through a filter, taking care not to disturb the precipitate. In the filtrate the phosphoric acid is estimated as magnesium pyrophosphate. The

* Read before the Manchester Literary and Philosophical Society, March 22, 1870. Communicated by Prof. Roscoe, Ph.D., F.R.S.

amount of the fluid employed in the determination is ascertained by again weighing the flask. On subtracting the weight of the tin-sulphide calculated from the quantity of the metal originally employed, we have all the data required to determine the amount of phosphoric acid in the entire solution.

This method of proceeding is not altogether faultless in principle. (1) It pre-supposes that from a known weight of tin-foil we are able to calculate the amount of tin-sulphide it will yield. Now the tin-foil of commerce is seldom or never pure, it almost invariably contains a considerable porportion of lead, often amounting to one-third of its weight,* and this of course passes into the nitric acid solution of the alkaline earths. (2) Since only a portion of the phosphoric acid present is actually weighed, the remainder being deduced by calculation, the chances of ultimate error are considerably increased.

These sources of error are removed by simply filtering and washing the tin-sulphide by means of the Bunsen "water-pump," an operation of comparative short duration. We thus obtain the whole quantity of phosphoric acid in solution, and entirely obviate the numerous weighings, involving, too, the very uncertain correction for the amount of tin-sulphide present.

In order to test the trustworthiness of the method thus modified, the following experiments were undertaken. A quantity of pure calcium phosphate was prepared by adding calcium chloride to an excess of sodium phosphate, and the precipitate washed, dried and ignited. About 0·5 grm. of this compound was weighed out into a porcelain basin, and dissolved in a small quantity of nitric acid; the solution was then concentrated, and the strongest nitric acid (boiling at 86° C.) added until the calcium nitrate commenced to separate out. This was immediately redissolved by the addition of a few drops of dilute nitric acid. The nitric acid solution is now in the highest possible state of concentration: on throwing a small quantity of tin into this solution, the metal is rapidly oxidised to stannic acid, and the supernatant liquid remains perfectly clear. The preliminary heating of the solution is indispensable, since in the cold the metal is apt to become passive, when it completely resists the action of the acid. The precipitate is now dissolved in a small quantity of caustic potash, and saturated with hydrogen sulphide; on adding acetic acid in slight excess the tin-sulphide is precipitated. The precipitate is then separated by means of the Bunsen "filter-pump," and the whole of the phosphoric acid is contained in the filtrate. After concentrating the solution, and again filtering from a minute precipitate of tin-sulphide, which invariably separates out (tin-sulphide being slightly soluble in solutions containing hydrogen sulphide), the phosphoric acid may be precipitated as the magnesium ammonium salt, and weighed as pyrophosphate.

I. Ratio of tin to phosphoric acid, 4 to 1.

	$Mg_2P_2O_7$.	P_2O_5.
I. 0·5135 grm. cal. phos. gave	0·405	= 50·45 per cent
II. 0·447 " " "	0·358	= 50·78 "
Mean		50·61 "

The lime was determined as caustic lime after removal of the lead by means of hydrogen sulphide. The mean of two concordant analyses gave 49·65 per cent of lime.

Hence the composition of the calcium phosphate is—

Phosphoric acid	50·61
Lime	49·65
	100·26

It is, therefore, evident that the amount of pure tin required need not exceed four times the weight of phosphoric acid present.

The following experiments show that this is, moreover, the minimum quantity that can be used.

* The tin-foil employed in my experiments contained 31·35 per cent lead.

II. Ratio of tin to phosphoric acid = 3·0 to 1.

	$Mg_2P_2O_7$.	P_2O_5.
0·477 grm. cal. phos. gave	0·307	= 41·53 per cent

III. Ratio of tin to phosphoric acid = 3·5 to 1.

	$Mg_2P_2O_7$.	P_2O_5.
0·598 grm. cal. phos. gave	0·388	= 41·50 per cent
0·434 " " "	0·304	= 44·82 "

In order to confirm the above results I have determined the proportion of lime and phosphoric acid contained in the calcium phosphate employed in the analyses, by dissolving the compound in hydrochloric acid, and adding sufficient sulphuric acid to precipitate the base. To each volume of the liquid two volumes of alcohol were added, and the mixture allowed to stand about twelve hours, when it was filtered and the precipitate thoroughly washed with alcohol. The filtrate containing the phosphoric acid is evaporated to dryness, the residue dissolved in water, and the acid precipitated as the magnesium ammonium salt. The lime was weighed as sulphate.

I. 0·525 grm. gave 0·411 MgP_2O_7 = 50·08 per cent P_2O_5
II. 0·507 " " 0·396 " = 49·96 per cent P_2O_5

The lime amounted to 50 per cent. Hence the composition of the calcium phosphate is—

P_2O_5	50·02
CaO	50·00
	100·02

exactly agreeing with the determinations made by the tin method.

ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Concluded from p. 158.)

LESSON VI. (continued).

THE length of cotton-fibre *(staple)* is determined by drawing out a tuft of the cotton repeatedly between the fingers, until the hairs are laid parallel, and then measuring the length of the tuft. This is the mode of measurement in use among cotton-brokers. An easy and accurate method of measuring single fibres of cotton had long been a desideratum in analytical operations. In 1862, Captain C. J. Mitchell, of the Government Central Museum, Madras, writes, respecting a process he had used for this purpose:—"It is exceedingly tedious, and very trying to both eyes and head." Shortly afterwards, the author endeavoured to measure single fibres by fixing them with gum upon a glass slide, making a drawing with the camera-lucida, and measuring the curved line so obtained with a map-measurer. The enlarged drawing was from 18 inches to 2 feet in length. The chief objection to this process was the amount of time occupied in the investigation, ordinary micrometrical operations not being applicable, on account of the great length of the fibres and the impossibility of measuring them as straight lines; hence the necessity of making drawings, and following all the curves with the little measuring-wheel. A simple and accurate process has been invented by Mr. C. O'Neill, and is described by him in a communication to the Literary and Philosophical Society of Manchester ("Memoirs," 1863—4, p. 389). The apparatus employed consists of a plate of glass, on which is ruled a scale 2 inches long, divided into tenths, a pair of fine forceps, and two camel-hair pencils. The scale is laid upon a piece of black cloth, and well lighted, by daylight or a lamp, with condensing-

lens. The fibres are selected, and held by the forceps, and, with one of the pencils, moistened in the mouth, pressed and drawn-out on the glass plate; the forceps are then dropped, and the other pencil brought into use to lay out the fibre, the length of which is then read off. The operation requires considerable practice, but, when acquired, single fibres can be measured to 0·05 inch with sufficient rapidity for analytical purposes. As some cotton-fibres—such as Sea Island—reach the length of 2 inches, it is well to have the scale extended to 3 inches: this will also prevent the necessity of being careful about placing the fibre on the beginning of the scale, as there will be plenty of space. And it is convenient to have a scale of about the same length divided into millimetres. For comparison with Continental observations, Mr. O'Neill gives the following results of some observations on the length of cotton-fibres:—

	Maximum. in.	Mean. in.	Minimum. in.
Sea Island	2·00	1·6800	1·35
Another sample	2·05	1·4440	1·10
Queensland	1·95	1·5010	1·10
Egyptian	1·55	1·2520	0·95
Pernambuco ..	1·50	1·6750	0·75
Surat	1·15	0·9425	0·75
Another sample	1·10	0·9250	0·55
Another sample	1·05	0·9050	0·70

In another communication (1862-3, p. 389), Mr. O'Neill describes an ingenious instrument for measuring the tensile-strength of fibres. The following are some of the mean breaking-weights of single cotton-fibres:—

	grs.
Sea Island	83·9
Another sample	90·0
Surat	105·8
Another sample	141·9
Egyptian	108·0
Another sample	127·0
Pernambuco	140·0

These determinations are of great value to the manufacturer. And those intending to make textile fabrics their study would do well to consult Mr. O'Neill's papers.

The amount of twisting in a thread is a very important element in the estimation of its strength. The famed Dacca muslins owe much of their superiority in lightness* and strength to the tightness of the twist in the delicate filaments of which they are composed. This has been determined by Dr. J. F. Watson, who gives the following as the average number of twists per inch in four samples of muslin:—French, 68·8; English, 56·6; Dacca, 110·1; Dacca (another sample), 80·7. The whole subject is carefully worked out by Dr. Watson in "The Textile Manufactures and Costumes of the People of India," pp. 59—74.

Cotton is mixed with other fibres legitimately in the well-known "union cloth," a compound of flax and cotton, and as an adulteration, with woollen fabrics, and in some specimens of lint.

Silk will be found to burn differently from the fibres of the two classes hitherto considered. It curls up, and ultimately fuses and burns, giving off the disagreeable odour common to animal tissues, as hair, wool, feathers, &c. The fibres depolarise light, giving more or less colour, but do not exhibit any structural peculiarities. Silk is entirely dissolved when boiled in strong solutions of caustic potash or soda. If *cautiously* heated on a slide in a strong solution of soda, the fibres will be found to swell, and bulge out in parts.

Admixtures of other fibres with silk are easily detected, by the appearance of the unravelled threads, under the microscope. The material most commonly used to adulterate silk is jute. The microscopical characters of this fibre are not of a very marked description. It is best distinguished by examining the residue under the microscope after the sample has been boiled in a strong caustic alkaline solution. Specimens of silk, breaking and fraying when pressed into tight folds, may always be suspected of containing jute: the beautiful gloss of this fibre, when carefully prepared, is the reason of its selection as an adulterating material.

Wool.—As already observed, this fibre presents very marked structural peculiarities. In burning, the same phenomena are apparent as in the case of silk; it is also soluble in hot alkaline solutions. The histological nature of the surface-markings may be considered undetermined at present, the apparent imbrications being interpreted by some as scales; and in many hairs (those of some of the bats especially) this character is very marked (M. C. Cooke, *Transactions of the Quekett Microscopical Club*, vol. i., pp. 33 and 55, Plates 1, 2, and 3; article, *Hairs of Animals*, "Micrographic Dictionary," p. 330; "Carpenter," p. 704).

Two valuable communications on "Wool, Commercially and Microscopically Considered" were made by Mr. N. Burgess to the Quekett Microscopical Club. Unfortunately, only abstracts appear in the *Transactions* (vol. i., p. 23). In this paper some important points of microscopical structure, bearing upon the felting process, are noticed. It is shown that the felting qualities of wool depend upon the number of waves or curvatures in the length of a fibre, and not upon the apparent serrations or imbrications.

When heated on a slide with strong solution of soda, wool swells, the medulla or interior cellular portion becomes more distinct, and the imbrications disappear, seeming to have unfolded.

Wool is mixed with other substances in the manufacture of fabrics generally with the view of improving the texture or appearance, and not usually as an adulteration.

Explosion of Fulminating Gold.—We are indebted to Mr. William A. Street for the following details of a curious explosion which lately occurred at a jeweller's establishment in Syracuse. A quantity of gold scrap had been dissolved in nitric acid and precipitated by ammonia. The entire material being then placed over a register to evaporate was left there, in an earthern jar, until dried. It was then removed, and when cool, the operator, who had evidently not studied the chemistry of gold, proceeded to scrape out the dry precipitate into a sheet of paper; a serious detonation soon occurred, and pieces of the jar were driven through a thick plate-glass screen, making clear holes, without cracks, so high was their velocity. We are not told of what became of the operator, but fear the worst. It is almost superfluous to add, that if, as is probable, an excess of ammonia was added in precipitating the gold, the entire process was exactly that given in most chemical works for producing fulminating gold in its most explosive condition.—*Communicated by Prof. Morton.*

* A piece of fine Dacca muslin, 1 yard wide and 10 yards 12 inches long, weighed only 1565 grains (Dr. Watson; work cited, p. 75).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

April 7th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows :—F. Andrews, jun., W. Martindale, A. H. Palmer.

Dr. DIVERS concluded his paper "*On the Combinations of Carbonic Acid with Ammonia and Water.*"

This elaborate and very extensive memoir does not permit of any abbreviation. Readers desiring more information are therefore referred to the *Journal of the Chemical Society*, which will, in one of the next numbers, publish Dr. Divers's investigations.

Dr. GLADSTONE communicated a paper "*On the Refraction Equivalents of the Aromatic Hydrocarbons, and their Derivatives.*"

In a previous paper (read before the Society on March 3rd), it was shown that, having ascertained the refraction equivalents of carbon, hydrogen, oxygen, nitrogen, and chlorine, the refractive values of a large number of compounds, built up by those elements, may be calculated with a close approximation to the truth. In the present paper, Dr. Gladstone treats with the exceptions to that rule. Phenylic acid, oil of bitter almonds, salicylic acid, methylic salicylate, methylic benzoate, ethylic benzoate, benzol, toluol, xylol, cumol, cymol, carvol, eugenic acid, pyridine, chinoline, aniline, nitrobenzol, chlorobenzol, naphthalin, and many others yet, give, by experiment, much higher refractive values than by calculation. A glance at the names of these exceptional substances will show that they consist of the aromatic hydrocarbons, with the bodies derived from, or related to, them. The refraction equivalents of the hydrocarbons themselves, and their chlorine substitution products, are about 6·0 above what theory requires; the compounds from creosote are a little higher still. The azotised products, and those containing C_7, are very nearly 8·0 above the calculated values, and hydride of cynnamyl is well known to be among the most refractive and dispersive of bodies. To what can this increased refraction be attributed? Dr. Gladstone thought first that the hydrogen in benzol and its congeners or derivatives might have a refraction value of 3·5 as in the hydracids of the halogens. But on investigating chlorhydranil, $C_6Cl_4O_2H_2$, where the greater part of the hydrogen is replaced by chlorine, and where the existing hydrogen is considered not to belong to the nucleus, are fraction equivalent of 7·6, that is, about the usual amount above the theoretical value, was obtained. Dr. Gladstone is now disposed to regard the nucleus, phenyl, C_6H_5, as an entity, having an exceptionally great influence on the rays of light, and this augmentation of refractive power has its analogy to that change in the refraction value which certain elements (for instance, iron and phosphorus), undergo when they alter their atomicity. This entity is not destroyed by the replacement of its hydrogen by chlorine, nitric oxide, oxygen, or sulphur. When, however, this nucleus is subjected to such chemical change as to break it up, the resulting products have only the ordinary effect on light.

Taking the difference of the figures obtained by experiment, and of those by calculation, it is found that the group of essential oils give refractive values of about 2 higher than required by theory; the phenyl group about 6 above the theory; the naphthalin group about 14; and the anthracen group about 17 above the calculated figures. Now, in these groups, the carbon increases in proportion to the hydrogen, and thus it becomes probable to arrange the above substances into certain series, which Dr. Gladstone regards, however, as merely a rough sketch, and by no means as a decided question. He hopes, at some future time, to say more on this subject.

Mr. HUNTER, of Queen's College, Belfast, communicated a paper on "*Analysis of Deep Sea Water*," a sequel to a note read before the Society in December last.

Messrs. BOLAS and GLOVES read a note "*On the Convenient Preparation of Bromo-picrin.*" They also gave preliminary announcement of the discovery of tetrabromide of carbon.

Professor How had sent a memoir "*On an Acid Feed Water from the Coal-field at Stellarton, Nova Scotia.*" The paper is chiefly remarkable by giving information of the presence of free oil of vitriol in the water which is used for feeding boilers.

For the meeting on April 21st, a lecture "*On Vanadium*," by Professor ROSCOE, is announced.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, March 28th, 1870.

Mr. E. C. C. STANFORD, F.C.S., Vice-President, in the Chair.

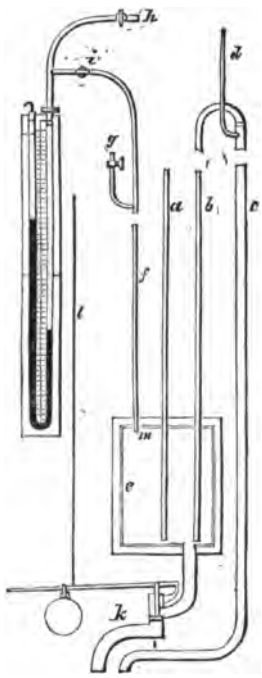
MR. T. L. PATTERSON read two papers. The first was entitled—"*On a Method for Obtaining a Continuous Current of Air or Gas under Pressure, for Blowpipe and other purposes.*

The author first explained how a continuous current of air or gas is obtained under ordinary circumstances, by the mouth blowpipe or the foot-bellows, and then mentioned the chief objections to those two methods, and proceeded to describe a method which he had found to be free from those objections. He said that it was well adapted to blowpipe work, and that he could easily obtain a pressure equal to half an atmosphere by means of it. The principle involved is the same as the Catalan blowpipe of Sprengel, and is wrought in connection with a Bunsen filter-pump, although it may be erected separately. The air-tap of a Bunsen pump being opened, the water is turned on, and air passes with the water down a long pipe, of 30 to 35 feet, in a continuous stream of bubbles. By receiving the stream into a bottle or other vessel, made air-tight with a cork, through which two tubes are passed, one nearly to the bottom of the vessel and the other just through the cork, the water will flow off by the deep tube, and air escape by the upper; and, by placing a stopcock on the upper tube, to regulute the escape of the air, the pressure in the vessel may be made equal to the height of the water-tube. The apparatus, as used by Mr. Patterson, is made of sheet-lead and "compo" pipes. Its arrangement is shown in the accompanying sketch. The internal diameter of the water-pipes is ½ inch, and of the air-pipes ¼ inch.

At *a* is shown the exhaust-pipe of the pump; it reaches to within ¾ of an inch of the bottom of the leaden vessel, *e*, which is 9 inches square and 1 foot high. This vessel, or *accumulator* is enclosed in a wooden box, by which its sides are supported. Two holes are pierced through the top, at opposite corners, and through one the water-pipe, *b*, passes to within ¾ of an inch of the bottom, and made air-tight. It is carried up along side of the exhaust-pipe as high as is necessary for the desired pressure, and then bent back, and soldered into a 1-inch pipe, *c*, which returns, and carries the overflow-water from the pressure-pipe, *b*, to the sewer. At *d* is shown a short piece of ¼-inch pipe, fixed into the waste-pipe, *c*, so that the latter may not act as a syphon. Into the other hole in the leaden vessel, *e*, a piece of ¼-inch pipe, *f*, long enough to reach to the laboratory, is soldered air-tight. One or more communications, as at *g*, may be taken off the pipe *f* to convenient places in the laboratory, and the pipe

itself is continued to the same manometer as is used to show the vacuum obtained by the pump. Just before the vacuum and pressure pipes unite, however, there is a cock soldered into each, so that, when the pump is working, the vacuum-cock, *h*, is open and the pressure-cock, *i*, is shut—the reverse being the case when the pressure apparatus is required. The mercury in the manometer gives the vacuum or pressure in m.m.

Beneath the vessel, *e*, is placed a lever stop-cock, *k*, of 1 inch diameter, to give free exit to the water while the pump is working for a full vacuum. This cock is wrought by means of wires, *l*, and pulleys, and thus, when the water is in the laboratory, the whole apparatus is under the operator's control. The mode of operating is as follows:—The lever-cock below the accumulator is opened, the vacuum and pressure cocks adjusted, and the water is turned on; and then the mercury in the near limb of the U-tube rises, and indicates a vacuum. But, when pressure is wanted (as for a blowpipe), the lever-cock is closed, the air-pipe of the pump gently opened, the manometer gently adjusted, and, when the mercury is at the



greatest height, the air is turned on to the blowpipe by the stopcock, *g*, and then the flame will continue regular, and as long as water and air flow down the exhaust-tube. The adjustment for the flow of water is the same for the pressure as for the vacuum apparutus.

This arrangement is suitable for conducting experiments under pressure, when that is not to be greater than half an atmosphere or so. In Mr. Patterson's apparatus, the pipe only rises to a height of 13½ feet, equal to a column of mercury 303·6 m.m., or 11·95 inches. The author had no doubt that the apparatus would work well up to nearly half an atmosphere, and probably more, if the tubes could be indefinitely lengthened, as the quantity of air delivered by the apparatus in a given time varies with the difference between the lengths of the exhaust and pressure pipes. A liquid may be boiled under the constant pressure of the apparatus by placing it in a strong flask, and connecting the latter (air-tight), by means of a flexible tube, with the pressure stop-cock; or it may be distilled by connecting the receiver (made air-tight to the retort or distilling-vessel) with the pressure stop-cock, as before. It will also be found useful for increasing filtration, by applying the pressure on the surface of the liquid to be filtered, when it is not desirable to use, or convenient to obtain, suction from beneath. Probably the most useful application of this air-current is to the blowpipe. With a Herapath lamp, it is easy, by means of the stop-cocks, to obtain a small oxidising or reducing flame suitable for chemical experiments, or the strong and powerful jet for glass-blowing and crucible operations.

The author had not tried the apparatus with a Griffin's blast gas-burner; but, from calculations made, he had no doubt that, with a Herapath lamp, he could get a blast quite as strong as that obtained by using the Griffin lamp. He stated that it would be desirable to have a float-valve at the mouth of the air-pipe, *m*, in the accumulator, to prevent the access of water into it, in the event of the apparatus at any time becoming deranged or overtaxed. In conclusion, the author explained how the apparatus might be used for delivering a steady current of any other gas not very soluble in water.

The cost of Mr. Patterson's apparatus, as fitted in connection with a Bunsen pump, is about 30s.

A discussion followed. Several members expressed themselves much interested in, and pleased with, the apparatus, as described by Mr. Patterson.

The other paper read by Mr. Patterson was, "*On an Explosive Balloon.*"

The author gave an account of some efforts which he made some years ago to fire explosive balloons on their ascent. At first he tried the india-rubber balloons of the toy-shops. From various causes, they had failed; but the chief difficulty was doubtless the tension, which made it difficult to secure the gases. Recently, the author's attention had been directed to the collodion balloons, obtainable of the philosophical-instrument makers, believing that they would suit well, both on account of their lightness, and on account of the fact that they would wholly disappear on ignition. After a number of trials, he had found them to succeed admirably. The method adopted was as follows:—A fuse of filter-paper, about 1 inch long and ¼ an inch broad, is gummed to the side of the balloon, near the mouth, and allowed to dry. The latter is then filled with a mixture of 2½ volumes of hydrogen gas and 1 volume of oxygen, the mixture being prepared in a separate vessel. The mouth of the balloon is at once tied with a piece of thread, to increase the force of the explosion. When the balloon is ready to ascend, a drop of the so-called "Greek fire" (that is, a solution of phosphorus in carbon disulphide) is placed upon the filter-paper; the thread is cut, and the balloon left to itself. In the course of half a minute or so, the explosion ensues. It is necessary to have an excess of hydrogen in the mixture, because exosmose takes place so rapidly that, by the time of ignition, the volume of that gas is sensibly reduced.

The author mentioned that, in the course of his experiments with collodion balloons, he had found a very sensible amount of heat generated in the collodion film. This he believed to be due to the oxidation of hydrogen in the pores of the collodion, somewhat similar to the action of spongy platinum or platinum-black on a mixture of the two gases.

NOTICES OF BOOKS.

First Report of the Commissioners Appointed in 1868 *to Inquire into the Best Means of Preventing the Pollution of Rivers. (Mersey and Ribble Basins.)* Vol. i. 1870.

(Continued from p. 164.)

WHILE pollution of rivers by sewage is a more ordinary feature of their contamination, we need not refer here to this point any further, but prefer to lay before our readers some curious facts in relation to pollution by manufac-

turing refuse, alluded to in general terms in the following words :—

"The operations carried on in bleaching, dyeing, and printing calicoes involve the pollution of large volumes of water, partly by mineral, but chiefly by organic matters. In most cases, the colouring matters, which it is the object of the manufacturer to fix upon the tissues, are contained in but very small proportion in the dye-stuffs employed ; thus the weight of actual colouring matter in 1 ton of madder is not more than 2½ lbs. ; hence, nearly the whole of these dye-stuffs is refuse matter, which, partly in solution, and partly in the solid condition, is carried by the goit of the mill into the adjacent stream. According to Mr. Robert Hammond (Messrs. Bradshaw, Hammond, and Co.), Reddish Vale Printworks, near Stockport, who has kindly made some careful experiments for us on this point, only 25 per cent of the madder used for dyeing goes into the stream in a state of suspension ; the remainder, being rendered soluble in the processes of dyeing and garancine making, consequently enters the stream in solution ; hence the large proportion of organic carbon and organic nitrogen in solution in the effluent water. Mr. Hammond states that 100 tons of ground Turkey madder-root leave, after being used for dyeing, 48½ tons of dry spent madder ; this, when made into garancine in the usual manner, and afterwards used for dyeing, leaves 25 tons of dry spent garancine. The returns show that this spent garancine is habitually put into the river or goit. With the exception of a small proportion of the mordants, and of the starch which is used in stiffening the finished goods, all the remaining chemicals find their way into the stream, since they are used in scouring, washing, and cleansing, and are not contained in the goods sent out of the factory. We may gain some idea of the extent of the pollution arising from the processes in question by considering the annual consumption of dye-stuffs, chemicals, and other materials, in one such factory of about average size. The Kinder Printing Company, at Hayfield, Derbyshire, have their works situated on the Kinder brook, a tributary of the Goyt ; they employ 250 hands, and use annually—

Madder	200 to 250 tons.
Peachwood	3·8 tons.
Logwood	26·0 ,,
Sumach	7·9 ,,
Sulphuric and muriatic acids	100 to 125 tons.
Soda-ash	50 tons.
Bleaching powder	14 ,,
Lime	about 30 ,,
Soap	44 ,,
Liquid arseniate of soda, containing 833·2 lbs. of metallic arsenic	19 ,,
Cow's dung	157 ,,
Starch	49 ,,
British gum	19 ,,

"The quantity of polluted water sent out from these works is estimated at 500,000,000 gallons per annum. It is passed through a series of small settling tanks, and then strained through canvas, to intercept the coarser particles of madder, which are either converted into garanceux and re-used for dyeing, or (exceptionally in these works) put upon land, or burnt. After passing the canvas strainer, the polluted water traverses rapidly a serpentine canal 258 yards in length, and then falls into a culvert, which conveys it below the next printworks on the stream, the works of the Hayfield Printing Company."

The result of the analytical researches made on this subject by the Commissioners show that the prominent character of this form of pollution is like that of sewage organic matter ; but the organic matter of dye-water is much less highly nitrogenised than that of sewage, and is therefore, presumably, less putrescible, and, consequently, less offensive. Amongst the mineral polluting materials "of calico-printworks, arseniate of soda alone demands especial notice. About fifteen years ago, it was discovered that arseniate of soda increased both the economy and efficiency of the dung-bath, and a mixture of cow's dung and arseniate of soda appears to have now to a great extent superseded the older mixtures in this part of the calico-printing process. Arseniate of soda (a compound of arsenic acid and soda, containing from 30 to 33 per cent of metallic arsenic) is excessively poisonous ; and it is fortunate that the amount required in the calico-printing process is but small when compared with the vast volume of water with which it is mixed. Nevertheless, analysis reveals a very appreciable proportion of arsenic in the effluent water from printworks. Thus, the polluted water flowing from the Kinder Printing Company's works contains, in 100,000 lbs., 0·032 lb. of metallic arsenic, equivalent to 0·042 lb. of arsenious acid or white arsenic. Although this proportion is so small that it would be necessary for an individual to drink no less than 138 gallons of the water in order to imbibe a fatal dose, yet it cannot but be considered undesirable that our rivers should thus become contaminated with such a poisonous ingredient."

The pollution by chemical works is described in the following manner :—

"The chief chemical works carried on in the basins of the Mersey and Ribble are devoted to the manufacture of soda alkali, soap, colours, and oxalic acid. The waste products are alkali waste, dilute muriatic acid (containing a considerable proportion of arsenic), burnt pyrites, chloride of manganese (containing arsenic), and chloride of calcium.

"The alkali waste is not thrown into the neighbouring river or stream, but it is stacked in enormous heaps, from which there drains a liquid containing much sulphuret of calcium in solution, and possessing an odour like that of putrid eggs.

"The burnt pyrites was formerly got rid of as rubbish, but it is now utilised, having been found to be of value as a source of copper.

"The dilute muriatic acid is, as a rule, run into the nearest stream or canal. Messrs. Crossfield, Brothers, and Co., return, as the amount of weak muriatic acid thus run away, 500,000 gallons annually (sp. gr., 1·005), which would contain about 1 per cent of real acid. Mr. A. E. Fletcher, one of the sub-inspectors under the Alkali Act, estimates the amount of free acid thus annually run to waste in the United Kingdom at 111,400 tons of real acid, or 371,133 tons of commercial liquid muriatic acid of 30 per cent strength. This is 45·5 per cent of the total quantity made.

"The chloride of manganese, though containing a valuable material, has not hitherto been utilised to any appreciable extent, and is consequently discharged into the nearest stream. Mr. Fletcher informs us that 54,000 tons of black oxide of manganese are annually consumed in the United Kingdom. Nearly the whole of this finds its way into the rivers as chloride of manganese, 57,500 tons of real muriatic acid being partly combined and partly mixed with it. According to the return of Messrs. Crossfield, Brothers, and Co., whose works are situated on the Sankey Canal, at St. Helen's, a single alkali work thus turns out, annually, as much as 1060 tons of manganese in the condition of chloride.

"The solution of sulphuret of calcium draining from the heaps of alkali waste meets, in the adjacent river, with the two waste products just mentioned, and undergoes, in contact with the dilute muriatic acid and acid chloride of manganese, a very unpleasant reaction, in which large quantities of sulphuretted hydrogen are given off into the surrounding atmosphere ; some sulphur and sulphuret of arsenic are thrown into suspension as a fine mud, and the solution of sulphuret of calcium is transformed into a comparatively innocuous one of chloride of calcium. The chloride of manganese also remains in solution, and the stream continues strongly acid.

"The worst case of river pollution from alkali works that we have met with occurs in the Sankey Brook, which receives the waste products from the St. Helen's alkali

works. Between St. Helen's and Warrington, the exceedingly offensive smell of this brook can be perceived at a distance of from one to two miles from its banks. When the wind blows from the west, it always unpleasantly surprises the passengers on the London and North-Western Railway between Warrington and Kenyon Junction. Leaving injury to health out of the question, it is no exaggeration to say that this brook renders the country within two miles of its banks uninhabitable, except under a penalty of so much discomfort as few would be prevailed upon to endure."

"The results of the analysis of the pollutions from alkali works are almost entirely of a mineral character, with much free acid, and, curiously enough, free sulphur, for we read—

"A sample of the mud taken from the Sankey Brook, just before its junction with the Sankey Canal, contained, when dried at 100° C., 22·75 per cent of free sulphur. A sample of sludge that had been recently dredged from the Sankey Canal, near its junction with the Sankey Brook, contained 3·97 per cent of free sulphur after drying at 100° C. When it is remembered that sulphur is worth from £6 to £7 per ton, and that 100 tons of the dried mud of the Sankey Brook contain 22¾ tons, and that nearly as much passes into the air as sulphuretted hydrogen, some conception may be formed of the vast quantity of valuable, and, as we shall presently show, recoverable material, which is thus thrown away and suffered to pollute both air and water to an intolerable degree."

It is quite impossible that, with the enormous mass of interesting details laid before us in this volume, we should be enabled to give here an exhaustive review; we cannot refrain, however, from noticing one of the curious consequences of the introduction of the use of pyrites instead of sulphur for the manufacture of sulphuric acid—

"Thus sulphur has been gradually, but at length completely, replaced by iron pyrites in the production of sulphuric acid for the alkali manufacture. Unfortunately, however, iron pyrites nearly always contains a notable quantity of arsenic, much of which passes into the sulphuric acid obtained from this material. Dr. R. Angus Smith, Your Majesty's Inspector of Alkali Works, informs us (Vol. II., "Minutes of Evidence," part 4), that 400,000 tons of iron pyrites are annually imported into this country for the alkali trade. At a moderate computation, we thus annually import 1600 tons of arsenic, a large proportion of which, there is every reason to believe, now finds its way into our rivers and streams. In the alkali factory, the sulphuric acid is employed to decompose chloride of sodium in a closed furnace. The arsenic is here transformed into chloride of arsenic, which, being volatile, passes off, to a great extent, with muriatic acid gas to the condensing towers, where it is dissolved by water and becomes a constituent of strong liquid muriatic acid, which is afterwards used in the manufacture of bleaching powder; and also of weak muriatic acid, which, as we have already described, is run directly into the nearest watercourse. The disposal, in like manner, of the arsenic in the strong muriatic acid is only postponed; it ultimately finds its way into the rivers as waste chloride of manganese liquor. But to return to the non-volatile product of the action of sulphuric acid upon chloride of sodium, technically called 'salt-cake,' which still retains a certain small proportion of the arsenic originally present in the sulphuric acid. This salt-cake is afterwards mixed with crushed chalk, or limestone and coal-dust; and the mixture is heated to incipient fusion in a reverberatory furnace. Here some of the arsenic must volatilise—indeed it might be expected that the whole of it would do so, did not the sequel prove this not to be the case; moreover, the coal-dust, which also contains arsenic, probably more than compensates for the loss. The product of this operation is termed 'black-ash.' It is afterwards lixiviated with water, and the lixivium, being evaporated to dryness, yields soda-ash. In some factories, the crystalline granules of soda-ash, as they are deposited during evaporation, are fished out of the boiling liquor, and are afterwards sent into the market as ash of first quality. The residual liquor being evaporated to dryness constitutes ash of the lowest quality, which will contain the largest proportion of arsenic, whilst the first quality ash may be comparatively or entirely free from the poison. In a series of samples kindly supplied to us from a large chemical work, we have clearly traced the arsenic from the original iron pyrites, through the different products just enumerated, up to this point. A certain proportion of soda-ash is re-dissolved in water, and then allowed slowly to crystallise; the soda crystals thus obtained are a true carbonate of soda, and constitute the common 'washing soda' of the shops. We have examined nine samples of washing soda obtained from as many oil shops, and found that only two of them contained the poisonous metal. The bicarbonate of soda, again, of the druggist is made from the soda crystals just mentioned. Two samples of this material were examined and found to be entirely free from arsenic.

"Soda-ash is extensively used in all bleaching and scouring operations; and thus arsenic is unconsciously introduced into a vast number of factories, as, for instance, that of Messrs. Bright and Co., at Rochdale. It is employed in the manufacture of soap, but is for the most part got rid of in the spent lye of soap works, a specimen of which contained 0·325 part of arsenic in 100,000 parts; hence, of six samples of soap which we have examined, only two contained arsenic, and in but very minute quantity. As soap and washing soda are used in most households, the poisonous metal is liable to gain admission into many dwellings; it is carried by the slops into the sewers, and, in London, is afterwards found in the sewage at Barking to the extent of 0·004 in 100,000 parts.

We are by no means disposed to take an alarmist view of this wide distribution of arsenic amongst the community; indeed, as we find it to be contained in very appreciable quantity in the rain which falls in London, being derived in this case from coal smoke, it is, doubtless, present in the rain-water of all our large towns, and consequently cannot be entirely excluded from rivers; nevertheless, its unnecessary introduction cannot but be regarded as, on many grounds, undesirable; and we believe that, so far as soda-ash and its derivatives are concerned, it might be easily prevented by submitting the 'salt-cake' and 'black-ash' to a somewhat more prolonged roasting, by which the arsenic, now partially driven off, would be completely expelled. We trust that, when the presence of this impurity becomes known to alkali manufacturers, they will direct their attention to remedy the evil, introduced into their processes chiefly by the substitution of iron pyrites for sulphur."

(To be continued.)

Proceedings of the American Pharmaceutical Association at the Seventeenth Annual Meeting, held in Chicago, Ill., September, 1869. Philadelphia. 1869.

This well got up volume, containing nearly 500 pages, is a most convincing proof of the flourishing, and, at the same time, highly scientific and efficient, *status* of the pharmaceutical branch of the medical profession in the United States, and the confirmation, also, of the truth of the "E Pluribus Unum," in another and not less highly creditable sense.

Since it is entirely out of the question to give more than a very superficial account of the contents of this work, we quote from the contents the following particulars:—As might be expected from the title, a very full account is given of the meetings held during six sittings. Next follow Reports of Committees; that of the Committee on the Progress of Pharmacy being, indeed, a masterpiece of its kind, including as it does pharmacognosy, pharmaceutical chemistry, and pharmaceutical legislation. We next meet an excellent report of

the Committee of Specimens, followed by a Report on the Pharmacopœia. Among the special reports, we notice those on Pharmaceutical Glass-Ware, and on Corks (this is a very interesting paper, full of generally-useful information). Among the volunteer reports and essays, we notice the United States' Cabinet of Practical Geology and Mining; while we regret that we cannot enter into particulars on this topic, we must not omit to call the attention of our readers to the short paragraph on this subject in our issue of February 18th last (CHEMICAL NEWS, vol. xxi., p. 83). Under the title of "The St. Louis Medical Spring," by Samuel S. Garrigues, we meet with the following analysis of a mineral water accidentally discovered at a depth of 200 feet below the surface, while borings were made for finding salt at St. Louis, Gratiot Co., Mich.:—Temperature of water, 50° F.; constant sp. gr., 1·011. Total mineral matter in a gallon, in grains, 270·60, viz.,—Sulphate of lime, 66·50; silicate of lime, 6·72; chlorine (curiously enough) only a trace; bicarbonate of soda, 106·40; bicarbonate of lime, 69·40; bicarbonate of magnesia, 17·50; bicarbonate of iron, 1·20; free silica, 2·88; organic matter and loss, 2·00;—total constituents, 272·60; free carbonic acid in gallon, 6·21 (*queritur*, what—grains or cubic inches?). This water is stated to carry a current of electricity, or, perhaps, magnetism (time did not allow to specify which). Under the heading of "Michigan Salt," by the same author, we meet with the two following analyses of samples of Saginaw salts, percentically and respectively composed of—Chloride of sodium, 93·892 and 95·327; chloride of calcium, 1·446 and 0·699; chloride of magnesium, 0·771 and 0·313; moisture, 3·430 and 3·308; sulphate of lime, 0·461 and 0·363. It need hardly be said that the volume before us contains a large amount of highly-interesting well-digested and collected information in regard to pharmacy in all its relations, but space forbids us to enter into further details.

MISCELLANEOUS.

Opera-House Dirt.—The dust obtained from the places of amusement in New York has recently been analysed by the scientific officers of the Metropolitan Board of Health. Over one hundred specimens of the particles floating in the air, and falling as dust, were collected on plates of glass, and were examined under the microscope. The proportions of the different ingredients varied, but the same substances were found in all the specimens. The composition of the matter subjected to the microscope was as follows:—"The dust of the streets in its finer or coarser particles, according to the height at which it had been collected, with a large proportion of organic elements; particles of sand, quartz, and feldspar; of carbon, from coal-dust and lampblack; fibres of wool and cotton of various tints; epidermic scales; granules of starch of wheat, mainly the tissues of plants; the epidermic tissue, recognised by the stomata or breathing pores; vegetable ducts and fibres, with spiral markings; vegetable hairs or down, either single or in tufts of four or eight, and of great variety, and three distinct kinds of pollens. Fungi were abundant from mere micrococcus granules to filaments of mould. When water was added to a portion of dust from whatever source, and exposed in a test tube to sunlight or heat for a few hours, vibriones and bacteria made their appearance, and the fungous elements sprouted and multiplied, showing that they maintained their vitality, and proving that the germs of fermentation and putrefaction are very widely diffused."—*Scientific American*.

Quality of the Gas Supplied to the Metropolis.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has reported to the Corporation of London and the Metropolitan Board of Works the quality of gas supplied to London under the provisions of the "City of London Gas Act, 1868;" and the following are the principal results:—1. *As Regards Illuminating Power.*—This has ranged the case of common gas from 16·70 standard sperm-candles to 17·84, the average of the different companies being as follows:—City Company, 16·95 candles; Chartered, at Leadenhall Street, 17·84 candles, at Gray's Inn Road, 16·70 candles, and at Arundel Street, 17·60 candles; and the Great Central Company, 17·46 candles. The illuminating power of the Cannel gas has been 24·12 candles in the case of the Chartered Company, and 26·09 in that of the City Company. 2. *In Respect of Purity.*—Sulphuretted hydrogen has been always absent from the gas of all the Companies, except on one occasion, when it was accidental. The average amounts of sulphur in other form than sulphuretted hydrogen were as follows:—9·54 grs. per 100 cubic feet of the Cannel gas of the City Company, and 25·82 (or nearly three times as much) in that of the Chartered Company; 14·19 grs. per 100 cubic feet of the Great Central gas; 19·99 grs. in the common gas of the City Company; and 22·47 grs., 24·43 grs., and 29·31 grs. in that of the several stations of the Chartered Company. These results show that the amount of sulphur in the gas of the Chartered Company is largely in excess of that of the City and the Great Central Companies; and considering the mischievous effects of this impurity, it is highly necessary that the proportion of it should be kept down to the smallest amount. Ammonia has been always absent from the City Company's gas; but it has ranged from 0·86 of a grain per 100 cubic feet to 4·9 grs. in the gas of the Chartered Company, the average for the quarter being 0·86 gr., 1·4 grs., 3·28 grs., and 2·1 grs. in the gas at the several stations of the Chartered Company, and 2·1 grs. per 100 cubic feet of that of the Great Central Company.

Humid Copper Process, Invented by Dr. Sterry Hunt.—The ordinary process for the manufacture of cement-copper consists in the solution of the copper compounds (generally by means of acids) and the precipitation of the metallic copper by the addition of iron. This method is open to two objections. One is the waste of iron, resulting from the fact that, of the iron added, a part remains in solution without precipitating any copper, and another part is itself precipitated with the copper. The other objection is the contamination of the product arising from this precipitation of a portion of the the iron with it. The ingenious process of Messrs. Hunt and Douglas obviates these objections by a change in the method of effecting a solution. The preliminary roasting of sulphuretted ores, and the final precipitation with metallic iron, are the same as in the ordinary process; but the chemical reactions of the solution are widely different. The evils we have alluded to arise from the acid solutions employed, and the per-salts of iron contained in them. The peroxide of iron in the bath, whether in combination with sulphuric or muriatic acid, absorbs a portion of the metallic iron, and becomes reduced to protoxide; while a portion of the per-salts falls in a basic, insoluble precipitate. These unstable per-salts should, if possible, be avoided. Again, the subchloride of copper contains twice as much copper in proportion to the chlorine as the protochloride. The ordinary precipitation substitutes iron for the copper of the protochloride, making metallic copper and protochloride of iron; but the same iron would suffice to expel 2 equivalents of copper from the dichloride. Thus—

$$Cu\,Cl + Fe = Cu + FeCl$$
$$Cu_2Cl + Fe = 2Cu + FeCl$$

It is evident, therefore, that the more dichloride of copper is present in the solution the less iron will be required for the precipitation. The theoretical amount required for a protochloride solution is, as we have said, 88·3 parts of iron for 100 of copper. The theoretical amount for dichloride is half as much, or 44·1 parts of iron. For mixtures of the two, the proportion of iron required by theory would vary between these two limits, according to

the proportions of the proto- and di- chloride of copper. But this desirable dichloride of copper is insoluble in water, and in the ordinary process its presence would be troublesome. The bath employed on the new process, however, permits its formation, and holds it in solution. This bath is a solution of neutral protochloride of iron, with a certain proportion of salt. The former acts upon the oxidised copper, producing a mixture of dichloride and protochloride, and precipitating at once peroxide of iron. The salt holds the copper salts in solution, and the liquid is drawn off from the insoluble residuum. From this liquid, by the addition of metallic iron, the copper is precipitated. By this means, all absorption or precipitation of iron in the last operation is avoided, and, at the same time, the theoretically-necessary quantity is reduced, since a large portion of the copper (about two-thirds) is dichloride. It is found easy in practice to produce 100 lbs. of pure cement-copper by the use of about 60 lbs. of iron.—*Engineering and Mining Journal*, U.S.A.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, April 4, 1870.

Leaving the purely mathematical, mathematico-physical, and similar papers, as also those belonging to natural history, unmentioned, this number contains the following papers relating to chemistry and collateral sciences:—

The Teacher of Descartes.—M. Jouglet.—The author has discovered, in the Municipal Library, at Tours, an unpublished manuscript bearing title, "In Universam Logicam Moralemque Philosophiam Commentarius Authore Celeberrimo Professore Grandillonio, ex convictu Flexensi," 1619. It is a well-known fact that Descartes (Cartesius) was educated at the College at La Flèche, but his teacher's name had not hitherto been found out. The author of this paper states that the manuscript is of great value, and deserves to be printed for public use.

Existence of Selenium in Commercial Copper.—Ch. Violette.—In order to detect the presence of this metalloid in copper, the author oxidises the metal, previously suitably cut up, by heating it to redness in a muffle. The oxide obtained is next placed in a combustion-tube and then placed in a gas or other furnace (as applied for elementary organic analysis), and heated to strong red heat for several hours in a current of dry and pure air (freed from aqueous vapour and carbonic acid. If any selenium be present, there will appear, at the cooler portion of the tube, just outside in front of the furnace, a white-coloured ring, composed of a volatile, crystalline, very hygrometric substance, readily soluble in water, and not coloured blue on addition of ammonia, which indicates absence of copper. The aqueous solution yields an abundant precipitate with nitrate of silver, which is soluble in excess of nitric acid. Reducing agents turn this white-coloured ring into a red-coloured substance, which exhibits all the reactions of selenium. The copper operated upon was from Chili.

Cause of the Acidity of the Water Collected in the Chloride of Calcium Bulbs Fixed to the Apparatus in Use for Elementary Organic Analysis.—Ch. Violette.—The author's researches prove that the acidity alluded to is due, partly to hydrochloric acid, and partly to selenious acid; the former being due to the omnipresence of hydrochloric acid in the air of chemical laboratories, and, as regards the latter, the cause has just been explained.

Formation of Formic Acid from Carbonic Acid.—E. Royer.—The author states that, while submitting to the action of a current of electricity an aqueous solution of carbonic acid, the latter was simply, by the addition of hydrogen, converted into formic acid.

General Theory of Chemical Action.—M. Maumené.—Of this memoir, which was not read, the Perpetual Secretary on duty at the meeting said that it contained a critical review of the labours of MM. Friedel and Crafts on silicium-ethyl.

Laws which Regulate the Expansion of Gases.—J. Dubrunfaut.—One of the most prominent points of this lengthy paper is the statement made by the author that even the driest air, or any other gas, contains always 5-10,000ths part of a gramme of aqueous vapour to the litre.

Object-Glass Provided with a Prism to be Used with an Ophthalmoscope.—M. Wecker and G. Roger.—By the contrivance of a prism for total reflection, the authors enable two parties to make observations simultaneously.

Application of Polarised Light to the Photographing of Microscopically-Small Crystals of some Salts.—J. Girard.—There was no paper read on this subject, but the photograms were exhibited.

Newly-Published Work.—H. de Parville.—M. J. Dumas highly eulogises the volume just published under the title of "Causeries Scientifiques" (Scientific Gossip). The eminent author reviews the recently-made progress in divers branches of science, and the applications thereof.

Although not belonging to chemistry or collateral sciences, we quote the title of the following paper, chiefly because France is indebted to M. J. Dumas for instituting this very useful *enquête* while he (now some 20 years ago) was the Minister of Agriculture, Commerce, and Public Works.

Communication of the Cases of Rabies which have Occurred in France during the Sexennial Period, of 1863 to 1868 inclusive.—M. Bouley.

Revue des Cours Scientifiques de la France et de l'Etranger, April 2, 1870.

This number does not contain any original papers or memoirs relating to chemistry or collateral sciences.

Revue Hebdomadaire de Chimie, March 24, 1870.

Description of an Apparatus Suited for Heating Molasses.—Lefèvreef-Lébvre.—This apparatus, illustrated by a woodcut, the author states, is highly economical, in consequence of the very small consumption of fuel, and that this apparatus is now being introduced for the heating of wines according to Pasteur's system.

Refining of Raw Sugars, and Extraction of Crystallisable Sugars from Molasses, by means of the Sucrate of Hydrocarbonate of Lime.—MM. Boivin and Loiseau.—This paper, although not a reproduction of another on the same subject, and already alluded to by us, partakes of the same defect, viz., of not lucidly and clearly describing the process, and of not in the least explaining what sucrate of hydrocarbonate of lime is, or how it is prepared.

New Process for the Preparation of Nitric Ether.—H. Lossen.—Nitric acid (sp. gr., 1·4) is heated with nitrate of urea (15 grms. to the litre) to boiling-point, and next left to become cold. 400 grms. of that acid are then taken, and mixed with 300 grms. of absolute alcohol; and thereto is added 100 grms. of nitrate of urea, and this mixture distilled from a tubulated retort. When about half the contents of the retort have been distilled over, a fresh portion of alcohol and acid added, by means of a proper funnel-tube. The 100 grms. of nitrate of urea are sufficient for obtaining 7 litres of this ether.

Moniteur Scientifique, No. 319, April 1, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Researches on the Ethers of Boracic Acid.*—H. Schiff.—This most extensive monograph is divided into the following sections, the titles of which we can only quote, since the work is not suited for any useful abstraction. In the introduction, the author discusses boracic acid, of which he assumes the existence of monoboric, biboric, triboric, tetraboric, and polyboric acids, illustrated by a series of complicated formulæ. We next have—Triethylic borate; monethylic borate; monethylic triborate; Ebelmen's boric ethers; methylic derivatives of boric acid; amylic derivatives of boric acid; mixed ethers of boric acid; monomethylic borate; boric anhydride and glycerine; boric anhydride and phenic alcohol; monophenic borate; tetraphenic diborate; boric anilide; supposed combination of chloride of boron and ether.

Adulteration of Catechu.—J. Tissandier.—It is a well-known fact that catechu is too often adulterated; and the sophisticated substance has often injuriously affected various operations wherein it is employed, especially dyeing and calico-printing. According to this author, genuine catechu, when exhausted by means of ether, loses 53 per cent of its weight, leaving, after drying, 47 per cent of residue. A mixture of catechu and alum gives a white precipitate with nitric acid and with chloride of barium.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Estimation of the Value of the Various Kinds of Cinchona Bark.—Dr. A. E. Vogl.—Forty grms. of the previously-pulverised

* This paper is not, in the strict sense, original; but, since it has been only published in the *Giornale di Scienze Naturale ed Economiche di Palermo* (vol. v., p. 9), we quote it here.

bark are intimately mixed with 10 grms. of quick-lime, and made into a thin paste with water; and this mixture is dried (the temperature is not stated). The dried mass is pulverised, and repeatedly exhausted with boiling alcohol at 90 per cent (600 c.c. are a sufficient quantity for this purpose); the alcoholic solution is filtered, and to the filtrate are added about 5 c.c. of dilute sulphuric acid. The ensuing precipitate of gypsum having been removed by filtration, the alcoholic fluid is submitted to distillation, and, after having been greatly reduced in bulk, is further evaporated to a very small bulk on a water-bath, whereby a flocculent, resinous, vanilla-like smelling aromatic substance is precipitated. After this material is again removed by filtration, to the filtrate is added a sufficient quantity of a solution of caustic soda as is required for the precipitation of all the alkaloids contained in the bark. These bodies are, by this mode of treatment, obtained in a high degree of purity in the shape of a white caseous, or crystallino-flocculent precipitate; this should be collected on a previously-tared filter, washed with the smallest possible quantity of water, and thoroughly dried, and next weighed. In order to separate the different bases from each other, the aforesaid precipitate is digested for twenty-four hours in a small flask with about 5 c.c. of ether. The ethereal solution is filtered off from the insoluble residue, which is first washed with ether, and next dissolved in alcohol. Each of the solutions so obtained is evaporated, yielding, in some instances, an amorphous, in others, a crystalline residue. These residues are dissolved in dilute sulphuric acid; and, after these solutions have been filtered, the alkaloids are precipitated from these solutions by means of a caustic soda solution, which has been titrated so as to correspond with the dilute sulphuric acid applied as just stated. This method of the estimation of the value of the cinchona barks is recommended by the author for the reason—(1) that it is easily and rapidly executed; (2) because it affords complete exhaustion of the valuable constituents of the bark, with very little, if any, loss; (3) because the bases are obtained directly in a high degree of purity. There are appended to this paper a series of results of analyses of various kinds of barks, made partly by this and partly by other well-known methods, as devised by scientific men who, like Dr. de Vrij, Dr. Rabourdin, and Prof. Schneider, are high authorities on this subject. From the results here published, this method deserves every praise.

On Arsenic-Free and Arsenic-Containing Aniline Colours.—Dr. Werner-Ertel.—The main gist of this paper, which contains some rather startling and curious, yet, unfortunately, not properly specified, statements, in respect of the extensive dissemination of arsenic in some of the German rivers, as a consequence of the large consumption of arsenic in the preparation of aniline colours, is, how to obtain fuchsine, and other similar preparations, free from arsenic, so as to render these substances fit for the colouring of sweetmeats, liqueurs, syrups, and pharmaceutical preparations.

Preparation and Qualitative Testing of Hydrate of Chloral.—Dr. Riecker.—A lengthy, but purely pharmaceutical paper.

Very Simple, but rather Rare, or Hitherto Undetected, Adulteration of Saffron.—Dr. W. Hallwachs.—The author states that, when he was, towards the end of last year, performing his duty as Inspector of Pharmacy and Pharmaceutical Chemists' Shops, he met with two instances of saffron having been adulterated with chalk; a fraud, he says, not so readily perceived as would appear, since it is only found out by taking a rather large quantity of the drug and placing it in water. Upon stirring the mixture, the chalk settles down on the bottom of the vessel, and may, of course, after having been washed with water, be readily tested. The author estimated the quantity in one instance, and found 17·5 per cent by weight; he also states that, in his opinion, this adulteration of this always rather expensive drug is made at the places where the saffron is grown, in order thus to increase the weight.

Decomposition of Ammonio-Phosphate of Magnesia.—Dr. N. Graeger.—The author states that he is in the habit of keeping a concentrated aqueous solution of this salt for the purpose of washing therewith the precipitate of the same salt obtained in well-known analytical operations. The aqueous solution alluded to, not having been required for use for at least six months, the author, on requiring it again, was astonished to find that, on the surface of the liquid, as well as on the layer of the salt at the bottom of the bottle, there was a film of pale golden-yellowish coloured substance; on opening the vessel which contained the solution, a very strong smell of phosphuretted hydrogen appeared. The quantity of the coloured material alluded to was too small to test even qualitatively, but the author thinks it might be phosphide of magnesium. The distilled water used for making the solution was pure, but not quite free from a small quantity of organic matter.

Annales de Chimie et de Physique, March, 1870.

This number contains the following original papers:—

Researches on Camphor, and on some of its Derivatives.—H. Baubigny.—Continuation and end of a very lengthy paper.

New Theory of the Electro-Dynamic Action.—M. Reynard.—An algebraico-physical essay.

Researches on the Combinations of Silicium with the Alcohol Radicals.—C. Friedel and J. M. Crafts.—This memoir is divided into the following sections:—Silicium-ethyl; oxide of silicium-triethyl; action of bromine on silicium-ethyl; action of bromine and iodine (jointly) on silicium-ethyl; action of iodine on silicium-ethyl; action of chlorine on silicium-ethyl; acetate of silicononyl; siliconylic alcohol; constitution of silicium-ethyl-bichloride; oxidation of silicium-ethyl; silicium-methyl; silicium-ethyl-methyl.

Experimental and Theoretical Researches on the Equilibrium Figure of a Liquid Mass which is Considered as Devoid of Weight.—J. Plateau.—Conclusion of a very lengthy and abstruse, yet very valuable, paper on this subject.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 4.

This number contains only one paper relating to chemistry—

Some of the Properties of Galvanically-Precipitated Iron.—R. Lenz.—This lengthy paper records a series of experiments, not only made with iron, but also copper. The results are stated as follows:—Iron and copper, when reduced to the metallic state by electricity, contain gases occluded, among which, hydrogen is in largest amount; the bulk of gas thus occluded varies considerably, but iron has been found by the author to occlude as much as 185 times its own bulk. The absorption of the gases is more considerable in the first layers of metal deposited. On being heated, the iron loses gas, even below 100°, the gas evolved at so low a temperature being chiefly hydrogen. Iron which has been galvanically precipitated, and then made red-hot and cooled, becomes oxidised when put into water, that liquid being decomposed and hydrogen given off.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 206, February, 1870.

This number is almost entirely filled with a lengthy report of the General Annual Meeting of this Society, held on the 11th of February last, under the presidency of M. J. Dumas. Among the reports of the prizes and medals given to a very large number of parties, the following may be noticed as being of general importance:—

Distillation of Beet-Root in the Rural Districts, as Carried Out by M. Champonnois's System, to whom the Argenteuil Prize of £500 is given.—M. Heuzé.—This is an excellent paper on a rural industry now of very great importance, not only for the production of alcohol, but also for fodder for cattle and the supply of farmyard manure.

Pyro-Electric Gilding Invented by M. Masselotte, to whom a Prize of £20 has been given.—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen.

Improvements in the Methods of the Preparation of Extracts from Dye-Stuffs, by M. Coez, to whom a Gold Medal has been awarded.—This process is briefly alluded to, having been already fully described some three years ago. From what is here stated, the extracts prepared by this method are in high reputation at Mulhouse, Rouen, and Lyons.

Animal Phosphated and Chlorinated Manure.—A silver medal has been awarded to Dr. Groualle and Dr. Boucherie for having successfully solved the problem of utilising dead cattle—viz., dying a natural death, and converting the carcases, in a very short time, to an excellent manure—saving the fat, and obviating any nuisance.

Annalen der Physik und Chemie, von Poggendorff, No. 2, 1870.

This number contains the following original papers:—

Thermo-Chemical Researches.—J. Thomsen.—The fourth and final part of this monograph, sub-divided into the following sections:—Boric acid; silicic acid; stannic acid; titanic acid; platinic acid (*platinsäure*); the fluorides of boron, silicium, titanium, tin, and platinum.

Circular Polarisation in some of the Six-Membered (Sechsgliedrigen) Hyposulphates.—C. Pape.

Some Peculiarities Relating to the Theory of the Capillary Phenomena.—J. Stahl.—A mathematico-physical essay.

On the Part Capillarity Plays in the Phenomena of the Spreading Out (Ausbrietung) of Liquids.—P. du Bois-Reymond.

Observations and Remarks upon Two Memoirs, by MM. von Bezold and E. Edlund, on Electrical Phenomena.—R. Clausius.

Historical Observation on the Publication of G. Magnus treating on the Reflection of Heat.—H. Knoblauch.

Relations Existing between the Changes of Bulk during the Formation of Solid Compounds and the Chemical Affinity of the Component Substances.—W. Müller.—Chiefly a series of tabulated forms, unsuited for any useful abstraction.

Preparation of Crystallised Silicic Acid by the Dry Way.—G. Rose.—The author records a series of experiments, chiefly of interest for mineralogy, as elucidating the formation of native crystalline silica.

Enstatite occurring in the Meteoric Iron of Breitenbach (Bohemia).—V. von Lang.—A purely crystallographical paper.

Crystalline Form of Hypersthene.—A. von Lang.—Also a crystallographical paper. Hypersthene is a mineral composed of silica alumina, protoxide of iron, protoxide of manganese, magnesia, lime and water.

Contribution to the Ozone Question.—O. Wolffenstein.—This essay is illustrated with engravings absolutely required for the proper understanding thereof.

Researches on the Compounds of Selenium and Sulphur.—A. Bettendorff and G. vom Rath.—This paper is chiefly a crystallographical essay respecting some compounds artificially obtained, the results of analysis of which are only approximatively given.

Electrical Action of Points (Spitzenwirkung).—Dr. J. C. Poggendorff.

Corroded Figures (Aetzfiguren) and Asterism in Iceland Spar.—Dr. H. Baumhauer.

Journal für Praktische Chemie, Nos. 22 and 23, 1869.

These numbers contain the following original papers and memoirs:—

Contribution to our Knowledge of Selenium.—Dr. B. Rathke.—This paper, a continuation of an essay on this subject, contains the following sections:—Estimation of selenium in organic compounds; carbide of selenium and selenium-xanthogenic acid; experiments for the preparation of selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid; observations concerning the organic derivatives of sulphurous and selenious acids, and also of sulphuric and selenic acids.

Ratanhine and its Combinations.—Dr. W. F. Gintl.—The commercial extract of rathannia contains a principle called ratanhine. The author, in the introduction to his paper, states that the substance known as angelin, and met with in the *Ferreira spectabilis*, is identical with ratanhine; and he has made use of that material (angelin) to prepare and analyse a lengthy series of compounds, among others, *ratanine ammonia*, no properly speaking constant compound of ammonia; and the substance named could be obtained, and different formulæ are quoted relating to the higher or lower temperatures at which the *pro tempore* existing compound was prepared, at 0° (32° F.). The formula is $C_{10}H_{13}NO_3+19NH_3$. Dry ratanhine does not combine with ammonia at all, if the latter be applied in the state of dry gas. There are further described a series of experiments to form compounds of ratanhine with the alkalies, soda and potassa, with baryta, strontia, lime, magnesia, and the oxides of heavier metals; the silver compound is $C_{10}H_{11}Ag_2NO_3$; behaviour of ratanhine with acids; and, lastly, speculative discussions on the constitution of ratanhine.

No. 1, 1870.

With this number begins a new series of volumes of this periodical, which is edited by Dr. H. Kolbe. The number opens with a table of the numbers of the equivalents of the elements and some of their compounds, it being, of course, understood that the several authors who are contributors to this paper may make use of such equivalents as they prefer; but, unless the contrary is distinctly stated, the table here referred to is the one adopted for this periodical. We next meet with a very lengthy series of the titles and abbreviations thereof of the various scientific periodicals, as they will be quoted henceforward in this work. The present number opens with a lengthy essay on the—

Task and Scope of Mineral Chemistry.—H. Kolbe.—Not at all suited for abstraction.

Identity of Naturally-Occurring Leucine with that obtained by Synthetical Methods of Preparation.—Dr. G. Hüffner.—A physiologico-chemical paper, the leading point of which is that all the three known leucines, and obtained by different methods, are identical, and not simply isomeric.

Some of the Derivatives of Oxysulpho-Benzide.—J. Annaheim.—This paper is divided into the following sections:—Ethyl-oxysulpho-benzide; nitro-ethyl-oxysulpho-benzide; tetra-chloroxysulpho-benzide.

Isomeric Succinic Acids.—H. Byk.—A very lengthy monograph, too full of formulæ to admit of any useful abstraction.

Crystalline Forms of Trithionate and Seleno-Trithionate of Potassa.—B. Rathke.—A crystallographical paper, illustrated with woodcuts.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 147, 1870.

This number contains the two following original papers, of which, although not exactly belonging to chemistry, we quote the titles—

Evaporation of Water of the Soil and of Plants.—E. Risler.

Dust Floating about in the Atmosphere.—A. de la Rive.

Cosmos, April 2, 1870.

Preparation of Photographic Figures on Glass.—E. Siegwart.—This paper contains a detailed account of the various operations required for fixing upon glass various designs.

Experiments on the Freezing of Wine.—A. Rousselle.—The reason why freezing improves wines, under certain conditions, is, according to this author, because, by freezing the proportion of all the fixed substances (*éléments*) in wine is increased, and these are, moreover, thereby rendered more fit for causing the combination of the acids with the alcohol, so as to form those ethers to which wine owes its peculiarly distinct flavour, aroma, and strength.

Revue Hebdomadaire de Chimie, March 31, 1870.

New Plan for the Method of Estimating the Market-Value of Molasses.—M. Mène.—This paper, chiefly of interest to beet-root sugar makers, enters, at some length, into the application of the areometer for ascertaining the value of the molasses; and next, the author discusses the plan of estimating the value of the molasses according to the alcohol it yields, stating that 100 parts of sugar should produce, in practice, 57 parts of alcohol at 90 per cent.

Description of an Improved Barometer for Use in Chemical Laboratories.—M. Alvergnat.—The description is not available without the woodcut; but the instrument is undoubtedly a very suitable one for the use it is intended for.

Annalen der Chemie und Pharmacie, February, 1870.

This number contains the following original papers and memoirs:—

On Fermentation, and on the Source of Muscular Force.—Dr. J. von Liebig.—The continuation and end of the celebrated author's lengthy essay on this subject, divided into the following main sections:—Acetic fermentation; the source of muscular power.

Experimental Researches made with the view to Elucidate the Causes upon which the Substitution of the Radical Hydrogen is made Dependent in Isomeric Butyric Acids.—Dr. Morkownikoff.—This very lengthy essay contains the following subdivisions:—Oxyisobutyric acid; reseaches on the different oxybutyric acids; the haloid hydrines of propylen-glycol.

Some of the Alcohols of Fermentation and Derivatives thereof.—J. Pierre and E. Puchot.—Not well suited for any useful abstraction.

NOTES AND QUERIES.

Barwood-Red and Indigo-Blue.—(Reply to "Chemicus.")—You may consult "Die Färberei der Gespinnste und Gewerbe von Reimann" (p. 28 and following, and 210 and following), where you will find a great many practical receipts.

Chlorate of Soda.—I cannot succeed in making chlorate of soda satisfactorily by means of tartrate of soda and chlorate of potash. Large proportions of the two salts remain undecomposed, and I found a sample of commercial soda chlorate nearly as bad as my own.—W. H.

Sulphate of Ammonia.—Would you kindly tell me what proportions of sulphate of ammonia, lime, and water (say, to 1 cwt. of sulphate) are used in practice for making liquor ammonia. I have no work that gives any particulars worth naming—Watts's "Chemistry" is rather too expensive.—A WORKING MAN.

Colouration of Glass.—I was to-day shown a piece of glass which lately formed a part of the Land's End light-house, the lamp of which was broken by a heavy sea some time back. This glass exhibited a rather striking peculiarity, the explanation of which I seek from the courtesy of your readers. The piece in question was about 3 inches long by 2 inches broad, and ¼ an inch thick, and was of a beautiful amethystine colour where, probably, acted upon by the light; but at the edge, where protected by putty or other sheltering material, the glass had entirely retained its white transparent hue. Not only was the surface affected in this manner, but the colouration apparently extended completely through the glass.—RIA.

[Such colouration, under the influence of light, is not uncommon when the glass contains manganese.—ED. C. N.]

MEETINGS FOR THE WEEK.

TUESDAY, 19th.—Institution of Civil Engineers, 8.
WEDNESDAY, 20th.—Meteorological, 7.
—— Society of Arts, 8.
THURSDAY, 21st.—London Institution, 7.30.
—— Zoological, 4.
—— Chemical, 8.
FRIDAY, 22nd.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

Chemicus.—It will not be published before the autumn.

P. Holland (Manchester).—Any work on Chemical Analysis will give you the information you require.

Bichrome.—The lead pump has not made the water hard; it has probably become so from natural causes.

THE CHEMICAL NEWS.

VOL. XXI. No. 543.

ON THE ETHYLIC SERIES OF SILICIUM.

By MM. C. FRIEDEL and A. LADENBURG.

THE observations, of which an account is here given, tend to prove the truth of the opinion expressed by M. Dumas, some thirty years ago, that hydrogen was not the only element susceptible of substitution, and that some body might be found capable of replacing carbon.

Sundry articles upon the subject, written first by MM. Friedel and Crafts, and afterwards by ourselves, show, in the first place, that silicium is a tetratomic element like carbon, and deserves comparison with it on that account; but the analogy does not end here. Silicium is capable of acting after the manner of carbon, and serving as a link for several hydrocarbonised groups by furnishing bodies presenting great analogy with certain hydrocarbides, and governed by the same law of saturation, provided the silicium be reckoned as an equivalent of the carbon, atom for atom. From these siliceous hydrocarbides several bodies may be derived, whose residues, containing silicium, united with carbon and hydrogen, and play the part of radicals exactly like simply hydrocarbonised groups. After studying a large number of compounds, forming what may be called the methylic group of silicium, it was necessary to find bodies corresponding to more elevated groups of the carbon series, and thus to show that silicium in groups analogous to organic compounds, may not only be saturated by atoms of carbon, but partakes with that element the property of saturating itself at least partially. This was at last effected after numerous fruitless attempts.

Upon endeavouring to remove from chloride of silicium a portion of the chlorine contained in it, so as to change it into a chloride more complex by one molecule, the silicium will be completely reduced if a metal be employed, such as sodium, zinc, or silver. In the case of hydrogen, which was used by Ebelmen for preparing sesquichloride of titanium, only a small quantity of silicichloroform was obtained.

It was believed that the iodine of silicium, SiI_4, discovered by one of us, would be attacked at a low temperature and would thus become better adapted to the end in view; experiments have justified the supposition. The iodide was heated for some hours at a temperature approaching its boiling point (290°—300°) with perfectly dry and powdery silver. The tetraiodide was then transformed into a white mass presenting a totally different aspect from its primitive appearance. Upon treating the contents of the vessel with a small quantity of sulphide of carbon, to extract any remains of tetraiodide, and after several washings, dissolving it in a large quantity of hot sulphide of carbon, the product consisted of beautiful colourless crystals, in hexagonal prisms or rhomboidal bases, acting upon polarised light after the manner of doubly refracting substances, and which fume in the air and decompose, forming a white substance. When treated with potash, a lively evolution of hydrogen ensues.

Analysis proves that these crystals are the iodide desired, Si_2I_6, formed by deducting one atom of iodine from the tetraiodide, and re-combining the two residues (SiI_3). The quantity of hydrogen evolved by the action of the potash confirms the result of the analysis, being $_2H$ in Si_2I_6, which should be, according to the equation—

$$Si_2I_6 + 4H_2O = 2SiO_2 + 6HI + 2H.$$

The hexa-iodide of silicium cannot be distilled either under atmospheric pressure or in a vacuum. It sublimes partially, but decomposes to a great extent into tetraiodide, leaving an orange-red residue, whose composition corresponds to the formula SiI_2, and which is insoluble in sulphide of carbon, benzol, chloroform, and chloride of silicium. This last iodide is changed by water into a white or greyish mass, evolving much hydrogen in the presence of potash. The hexaiodide melts in a vacuum, but with partial decomposition at a temperature of 250°. It is much less soluble than the tetraiodide in sulphide of carbon at 27°; one part of this liquid dissolves 2·2 parts of SiI_4 and only 0·26 of Si_2I_6. When crystals of the hexaiodide are thrown into iced water, they decompose without evolution of hydrogen, and the white substance, which remains when dried in a vacuum at 100°, presents a composition corresponding to the formula $Si_2O_4H_2$, which is proved by the quantity of hydrogen disengaged by the potash or collected as water, by combustion with oxygen, and by calcining the mass which decomposes with incandescence, and an evolution of hydrogen, leaving a residue of silica, whose weight is almost identical with that of the primitive substance. The iodide of silicium is transformed into a hydrate, $Si_2(OH)_6$, upon contact with water; this hydrate loses $2H_2O$ to form the body, $Si_2O_4H_2$, whose composition is analogous to oxalic acid, and which may be called silici-oxalic hydrate.

Salts of this compound could not be obtained. They became decomposed by even the weakest bases, with evolution of hydrogen, as is done by potash under other circumstances in the case of oxalic acid.

Several reactions were tried with the hexaiodide with a view to obtaining a volatile compound without decomposition. After ascertaining that bromine extracts all the iodine from the iodide, and transforms it into a bromide, and that the iodine is capable of reacting on alcoholate of soda, and thus forming an ethereal compound, the action of zinc-ethyl on the hexaiodide was next examined.

Upon mixing the latter with the former in small portions at a time, and gently heating it, a reaction is produced, and a white substance precipitated. When a suitable proportion of iodine (Si_2I_6 for $3ZnEt$) has been added, the reaction is finished; it is then distilled, and the distilled product treated with water to decompose a slight excess of zinc-ethyl. After decanting the water, it is repeatedly washed in concentrated sulphuric acid to remove a substance which is soluble in that liquid, and which appears to be triethyl oxide of silicum. It is then again washed with water, dried, and fractionally distilled; two liquids are thus separated; one, boiling at from 150° to 154°, is siliciumethyl, $Si(C_2H_5)_4$; and the other, which was obtained between 250° and 253°, gives, on analysis, numbers agreeing with the formula $Si_2(C_2H_5)_6$. It is a limpid liquid, with a faint smell, resembling that of siliciumethyl and burns with a brilliant flame, giving forth fumes of silica. Upon ascertaining the density of vapour, the figures obtained approached very nearly to those required by the theory for the formula $Si_2(C_2H_5)_6$, but somewhat higher (theory 7·96 exp. 8·5). The liquid does not alter sensibly at 300°, but alters slightly, with formation of a product soluble in sulphuric acid, which is doubtless triethyl oxide of silicium, $Si_2O(C_2H_5)_6$, which is formed by oxidation of siliciumhexethyl. The presence of this body explains the slight excess of the found density as compared with the theoretical density. The exactitude of the formula, $Si_2(C_2H_5)_6$, is beyond doubt; consequently the series of compounds here spoken of certainly belong to the ethylic group of silicium. The two atoms of silicium are directly connected, and serve as a link to the atoms of iodine, or of oxygen and hydroxyl, or ethyl, which combine with them to form the molecule. The reaction of the zinc ethyl upon the hexaiodide takes place in an exactly similar manner to that of the same body upon the chloride and the iodide of silicium, and furnishes a compound which may be considered as homologous with

siliciumethyl. The study of the reactions of this body will doubtless be interesting, and will probably show that the analogy is not confined to the formulæ.—*Comptes Rendus.*

ON THE COMPOSITION OF THE WATER OF THE IRISH SEA.*

By T. E. THORPE, Ph.D., and Mr. E. H. MORTON.

Thanks to the investigations of Forchhammer, Von Bibra, Bischof, and others, our knowledge concerning the nature and distribution of the saline constituents of sea-water and of the causes of the variations in its composition as observed in various parts of the world, is tolerably extensive and precise. English chemists, however, have contributed next to nothing to the general stock of our information on this subject. This is not a little remarkable, especially when we consider the peculiarly favourable condition in which this country is placed for researches of this kind, by reason of its insular position. A few observations by John Davy made in the course of his long voyages, two memoirs by Marcet in the "Philosophical Transactions" for 1819 and 1822 on the temperature and saltness of various seas, and an elaborate analysis by Schweitzer of the water of the English Channel made in 1838, constitute by far the chief portion of the work done in this direction by English chemists. The chemical history of the sea is mainly to be derived from the researches and observations of chemists principally French and German, the majority of whom were located at considerable distances from the sea-board, and who laboured therefore under all the disadvantages which this circumstance necessarily entails. So far as we can learn the water of the Irish Channel has never been analysed. We have been induced, therefore, to undertake its analysis in the hope of supplying information respecting the nature and extent of the modifications effected in the composition of the sea by its proximity to our coasts. Accordingly Captain Temple of the "Bahama Bank" Light Ship kindly collected for us a quantity of the water in the immediate neighbourhood of his vessel. The vessel is situated in lat. 54° 21′ N. and long. 4° 11′ W., seven miles W.N.W. of Ramsey, Isle of Man, and is placed nearly equi-distant from the shores of England, Scotland, and Ireland. During the greater part of the day a strong current setting in from the south, probably from the Atlantic, flows past the ship into the North Channel, and thence again into the Ocean. The water, therefore, taken for analysis, was originally that of the deep ocean, which had traversed almost the entire length of the Irish Channel, and had consequently been exposed to all the influences due to the neighbouring sea-board, and to the influx of the numerous rivers along the coasts.

The water was obtained in the early part of January, 1870; the meteorological conditions at the time of collection, and for some time previously, were in no wise remarkable. The analysis was commenced immediately on receipt of the water. Its specific gravity compared with distilled water, free from air, and possessing the same temperature, was found to be—

At 0° C.	1·02721
At 15° C.	1·02484

These numbers differ but slightly from that usually accepted as representing the mean specific gravity of the water of the ocean. The water of the Atlantic, according to Von Horner, possesses the specific gravity 1·02875 at 0° C.; that of the English Channel at 15·5° was found by Schweitzer to be 1·0271: on nearing the land the specific gravity fell to 1·0268.

* Read before the Manchester Literary and Philosophical Society, March 22, 1870.

Full details of the methods of analysis employed are given in the original paper. The following synopsis shows the mean results of the determinations: the numbers express the amount of the various ingredients in 1000 grms. of the sea-water.

1	Chlorine	18·62650
2	Bromine	0·06133
3	Sulphuric acid (SO_4) ..	2·59280
4	Lime (total)	0·57512
5	Calcium carbonate	0·04754
6	Magnesia	2·03233
7	Mixed alkaline chlorides ..	27·18363
8	Potassium	0·39131
9	Sodium	10·40200
10	Ferric oxide	0·00465
11	Ammonia	0·00011
12	Nitric acid	0·00156
13	Fixed constituents	33·83855

These substances arranged on the assumption that the strongest acid is united with the strongest base, yield the following numbers:—

Sodium chloride	26·43918
Potassium chloride	0·74619
Magnesium chloride	3·15083
Magnesium bromide	0·07052
Magnesium sulphate	2·06608
Magnesium carbonate	traces
Calcium sulphate	1·33158
Calcium carbonate	0·04754
Lithium chloride	traces
Ammonium chloride	0·00044
Magnesium nitrate	0·00207
Silicic acid	traces
Ferrous carbonate	0·00503
	33·85946
Amount directly determined	33·83855

The water employed in the foregoing analysis was collected in midwinter. It becomes interesting to know if its composition is uniform during the various seasons of the year. Fortunately we can offer some evidence on this point. In August, 1865, after a continuance of exceptionally fine weather, one of us collected some sea-water in the neighbourhood of the "Bahama Bank" Light Ship, and determined the total quantity of its saline constituents, together with the amount of chlorine and sulphuric acid. The proportion of solid matter contained in the water of the Irish Sea is somewhat greater in summer than in winter—the variation amounting to 0·0144 per cent—but the relative amount of solid matter present in the water of the Irish Channel is invariably less than is contained in the water of the Atlantic Ocean lying between the same parallels.

According to Forchhammer, the mean proportion of the leading constituents of the water of the Atlantic far away from the shores is as follows:—

	Cl.	SO_3.	CaO.	MgO.	Total Salts.
Absolute amount in 1000 grms.	19·865	2·362	0·588	2·199	35·976
Relative amount ..	100	11·89	296	11·07	181·10

Arranged in this manner, our determinations on the water of the Irish Sea give the following proportions:—

		Cl.	SO_3.	CaO.	MgO.	Total Salts.
Absolute amount per 1000 grms.	Summer ..	18·735	2·187	—	—	34·082
	Winter ..	18·627	2·161	0·575	2·032	33·838
Relative amount.	Summer ..	100	11·67	—	—	181·91
	Winter ..	100	11·63	3·09	10·93	182·09

RESEARCHES ON VANADIUM.*

PART III. PRELIMINARY NOTICE.

By HENRY E. ROSCOE, B.A., F.R.S.

I. METALLIC VANADIUM.

IN the second part of "Researches on Vanadium," it was stated that the metal absorbs hydrogen. This conclusion has been fully borne out by subsequent experiment: and it appears that the amount of absorbed or combined nitrogen taken up by the metal varies according to the state of division—first, of the chloride (VCl_2) from which the metal is prepared, and secondly, and especially, of the metal itself. The metal containing absorbed hydrogen slowly takes up oxygen on exposure to the air, water being formed and the metal undergoing oxidation to the lowest oxide, V_2O. At this point the oxidation stops.

The difficulty of obtaining metallic vanadium free from admixture of oxide has been again rendered evident. Perfectly pure tetrachloride was prepared in quantity, and from this pure dichloride was made. On heating this to whiteness for forty-eight hours, a substance was obtained which gained, on oxidation, 70·7 per cent (vanadium requiring 77·79 percentage increase), and, therefore, still contained a slight admixture of oxide.

The reducing action of sodium on the solid chlorides was next examined; in this case, the reduction takes place quietly in an atmosphere of hydrogen at a red heat, and is best conducted in strong iron tubes. Explosions occur when sodium acts on the liquid tetrachloride. The substance thus obtained was found, after lixiviation, to be free from chlorine, and on washing it separated into two portions—(1) a light and finely-divided black powder (trioxide), which remains in suspension, and is soluble in hydrochloric acid; and (2) a heavier grey powder, insoluble in hydrochloric acid, which soon deposits, and can, by repeated washing, be completely freed from the lighter trioxide. This bright grey powder consists of metallic vanadium, mixed with more or less oxide. If this metallic powder, after drying *in vacuo*, be reduced at a low red heat in a current of pure hydrogen, the powder, even when cold, on exposure to air or oxygen, takes fire spontaneously, water being formed, whilst the vanadium undergoes oxidation, forming the blue oxide, V_2O_4. A portion of metal exposed for some weeks to the air also slowly absorbed oxygen, passing into the oxide, V_2O.

II. VANADIUM AND BROMINE.

1. *Vanadium Tribromide*, VBr_3; molec. wt. = 291·3.—When excess of bromine is passed over vanadium mononitride heated to redness, a vivid action occurs, and dense dark-brown vapours are formed, condensing in the cooler portions of the tube to a greyish black, opaque, amorphous mass of the tribromide. The tribromide is a very unstable compound, losing bromine even when kept sealed up in glass tubes; it is very deliquescent, and, on heating in the air, rapidly loses all its bromine and takes up oxygen, with formation of vanadic acid. On being thrown into water, the tribromide readily dissolves, forming a brown liquid (in this respect resembling the trichloride), which, on addition of a few drops of hydrochloric acid, turns of a bright green colour, showing the presence of a solution of an hypovanadic salt. No free bromine or hydrobromic acid is given off on dissolving the tribromide in water. That a more volatile higher bromide was not formed in this reaction was shown, inasmuch as, on distilling the excess of liquid which had collected in the receiver, it was found to consist of free bromine, containing mere traces of the tribromide mechanically carried over. The tribromide is likewise formed when bromine is passed over a red-hot mixture of vanadium, trioxide, and pure charcoal, as in the preparation of the tetrachloride; but this method is not one to be recommended, as the tube becomes constantly stopped up by the formation of the solid tribromide.

The analysis of the tribromide was made by dissolving the compound in water, and precipitating the bromine with excess of nitrate of silver, the vanadium being estimated as V_2O_5, either in the filtrate from the bromide of silver or in a separate portion. The bromine in the above determinations, obtained by precipitation as silver-salt, was invariably found to be too high, whilst the vanadium nearly agreed with the theoretical percentage. This is due to the fact pointed out by Stas, in his "Recherches" (p. 156), that bromide of silver, when boiled, encloses, mechanically, a portion of the precipitant, which then cannot be washed out. The loss of weight obtained by reducing the bromide to metallic silver in a current of hydrogen, taken as bromine, gave more nearly agreeing numbers:—

		Calculated.	Mean of 6 determinations.
Vanadium ..	V = 51·3	17·61	18·44
			Mean of 3 determinations.
Bromine ..	Br_3 = 240·0	82·39	80·86
	291·3	100·00	99·30

2. *Vanadium Oxytribromide*, or *Vanadyl Tribromide*, $VOBr_3$, molec. wt. = 307·3.—The oxytribromide is a dark-red transparent liquid, evolving white fumes on contact with the air, obtained by passing pure and dry bromine over vanadium trioxide (V_2O_3) heated to redness. Moisture prevents the formation of the oxytribromide; and it not only undergoes sudden decomposition when heated to 180°, but also slowly decomposes at the ordinary atmospheric temperatures. The boiling-point of the tribromide can, however, be brought below the temperature of decomposition by distillation *in vacuo*, and the liquid can then be freed completely from bromine by passing a current of dry air through the liquid. Under a pressure of 100 m.m., the oxytribromide boils from 130° to 135, and may be distilled almost without decomposition. Vanadium oxytribromide dissolves in water, yielding a yellow-coloured solution, in which both vanadium and bromine were determined, after reduction with sulphurous acid—

	Calculated.	Mean of several analyses.
V .. .. .. =	51·3	16·69	16·75
Br_3 .. .. .. =	240·0	78·10	79·20
O .. .. .. =	16·0	5·21	——
		100·00	

The sp. gr. of the oxytribromide, at 0°, is 2·967.

3. *Vanadium Oxydibromide*, or *Vanadyl Dibromide*, $VOBr_2$, molec. wt. = 227·3.—This is a solid substance, of a yellowish brown colour, obtained by the sudden decomposition of the foregoing compound at temperatures above 100°, or by its slow decomposition at the ordinary temperature.

The oxydibromide is very deliquescent, dissolving in water, with formation of a blue solution of a vanadious salt. When heated in the air, it loses all its bromine, and is converted into V_2O_5.

Analysis gave—

	Calculated.	Mean of several analyses.
V .. .. .. =	51·3	22·570	22·45
Br_2 .. .. .. =	160·0	70·390	70·93
O .. .. .. =	16·0	7·104	——
	227·3	100·000	

III. VANADIUM AND IODINE.

Iodine vapour does not attack either the trioxide or the nitride at a red heat; both these substances remain unchanged, and no trace of vanadium can be detected in the iodine which has passed over them.

* Read before the Royal Society, April, 1870.

IV. The Metallic Vanadates.

In the first part of these Researches (*Phil. Trans.* 1868), it was pointed out (1) that the salts analysed by Berzelius must be considered as meta- or mono-basic vanadates, (2) that the so-called bivanadates analysed by Von Hauer are anhydro-salts, and (3) that the ortho- or tribasic vanadates contain 3 atoms of monad metal, the sodium salt being formed artificialy by fusing 1 molecule of vanadium pentoxide with 3 molecules of carbonate of soda, when 3 molecules of carbon dioxide are expelled, whilst the orthosalts occur native in many minerals. The present communication contains a description of these classes of salts, as well as of a new class of salts, the tetrabasic or pyro-vanadates.

Sodium Vanadates.

1. *Ortho-* or *Tri-Sodium Vanadate*, $Na_3VO_4+16H_2O_2$.—When a mixture of 3 molecules of Na_2CO_3 and 1 molecule of V_2O_5 is fused until no further evolution of CO_2 is observed, a tribasic vanadate remains as a white crystalline mass. This mass dissolves easily in water, and on addition of absolute alcohol to the solution two layers of liquid are formed; the lower one solidifies after a time, forming an aggregation of needle-shaped crystals, which possess a strongly alkaline reaction. These having been washed with alcohol, and dried on a porous plate over sulphuric acid *in vacuo*, were analysed with the following results:—

		Calculated.	Found.
Na_3	= 69·0	14·60	13·80
V	= 51·3	10·86	10·86
O_4	= 64·0	13·56	—
$16H_2O$	= 288·0	60·97	60·44
	472·3	99·99	

The sodium in this and in the following compounds was separated from the vanadium by precipitating the vanadic acid as the perfectly insoluble basic lead salt hereafter described. This was dried at 100° and weighed, then dissolved in nitric acid and decomposed by sulphuric acid, and the solution of V_2O_5 in excess of this acid gave, on evaporation, a finely crystalline mass. The filtrate from the lead precipitate freed from lead yielded on evaporation sodium sulphate. Full analytical details of this method, as well as of the other by precipitation, as the insoluble ammonium metavanadate, are given in the memoir. By frequent crystallisations the tri-sodium vanadate is slowly decomposed into the tetrasodium salt, caustic soda being formed. This singular reaction was most carefully examined and the amount of sodium hydroxide liberated determined diametrically.

2. *Tetrasodium Vanadate*, $Na_4V_2O_718H_2O$.—This salt crystallises in beautiful six-sided tables. It is easily soluble in water, insoluble in alcohol, and is precipitated by the latter liquid from aqueous solution in white scales of a silky lustre. As long as the salt contains free alkali or tribasic salt, it forms, on precipitation with alcohol, oily drops which solidify after some time. The tetrasodium vanadate is always formed by the first fusion of vanadic acid with excess of carbonate of soda, and can be easily prepared in the pure state by re-crystallisation.

		Calculated.	Found (mean of several determinations).
Na_4	= 92·0	14·58	14·61
V_2	= 102·6	16·27	15·97
O_7	= 112·0	17·27	—
$18H_2O$ ..	= 324·0	51·38	51·80
	630·6	99·99	

The salt loses 17 molecules of water at 100°.

The corresponding Calcium and Barium Vanadates, $Ca_2V_2O_7$, and $Ba_2V_2O_7$, are white precipitates obtained by adding the chlorides to a solution of tetrasodium vanadate. If calcium chloride be added to a solution of the trisodium salt, dicalcium vanadate is precipitated, the solution becoming strongly alkaline from formation of calcium hydroxide and absorbing carbonic acid from the air. Complete analysis showed that the calcium salt contains 2½ molecules of water of crystallisation, whilst the barium salt is anhydrous.

Lead Vanadates.

1. *Tribasic* or *Ortho-Lead Vanadate*, $Pb_32(VO_4)$.—Obtained as a light yellow insoluble powder on precipitating the tribasic sodium salt with a soluble lead salt; it yielded on analysis 11·75 per cent of vanadium, the calculated quantity being 12·04 per cent.

2. *Vanadinite, the Double Ortho-vanadate and Chloride of Lead*, $3Pb_3VO_4+PbCl_2$, can be artificially prepared by fusing for a few hours a mixture of vanadic acid, oxide of lead, and chloride of lead, in the above proportions, together with an excess of sodium chloride. After cooling, a greyish crystalline mass is left, containing cavities filled with long crystals having the same colour as the mass, which under the microscope could be distinguished as six-sided prisms. The crystalline powder is then boiled with water until no further traces of soluble chlorides are extracted.

The following analysis shows that this substance has the same composition as the vanadinites from Zimapan and Windischkappel, analysed by Berzelius and Rammelsberg.*

		Natural vanadinite.		
	Calculated. $3(Pb_3VO_4)PbCl_2$.	Zimapan, Berzelius.	Windischkappel, Rammelsberg.	Artificial vanadinite.
Lead	73·08	70·40	71·20	71·96
Vanadium ..	10·86	—	9·77	11·11
Chlorine ..	2·50	2·54	2·23	2·31
Oxygen ..	13·55	—	—	—

The specific gravity of the artificial vanadinite at 12° C. is 6·707, that of the natural being 6·886.

3. *Basic Di-Lead Vanadate*, $2(Pb_2V_2O_7)+PbO$.– Acetate of this salt is precipitated as a pale yellow powder when lead is added to a solution of disodium vanadate, the liquid acquiring an acid reaction. It is completely insoluble in water and in dilute acetic acid, but dissolves readily in nitric acid.

		Calculated.	Mean found.
Pb_5	= 1035·0	69·92	70·18
V_4	= 205·2	13·86	13·30
O_{15}	= 240·0	16·22	—
	1480·2		

Silver Vanadates.

1. *The Ortho-silver Vanadate*, Ag_3VO_4, is obtained as an orange-coloured precipitate by mixing a freshly prepared solution of the trisodium salt with a solution of silver nitrate, in which every trace of free acid has been neutralised; unless these precautions are attended to, the precipitate consists of a mixture of the ortho- and pyro-salt. The tri-silver vanadate is insoluble in water, but readily dissolves in ammonia and nitric acid. Analysis gave the following results:—

		Calculated.	Found (mean).
Ag_3	= 324·0	73·75	73·83
V	= 51·3	11·67	11·76
O_4	= 64·0	14·58	—
	439·3	100·00	

2. *The Tetrabasic Silver Vanadate*, $Ag_4P_2O_7$, is prepared by mixing a solution of the corresponding sodium salt with a neutral solution of nitrate of silver. It falls as a yellow dense crystalline precipitate, resembling in colour the ordinary phosphate of silver. On dissolving the salt in nitric acid, the silver is precipitated as chloride, and the vanadium determined as V_2O_5.

* Pyromorphite and apatite have already been artificially prepared by Deville and Caron, and also by Debray, whilst mimetesite has been obtained artificially by Lechartier.

Analysis gave :—

		Calculated.	Found.
Ag_4	= 432·0	66·81	66·45
V_2	= 102·6	15·87	15·97
O_7	= 112·0	17·32	—
	646·6	100·00	

I have to thank Messrs. Œlhofer and Finkelstein for the valuable assistance which they have given me in the above investigation.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 1st, 1870.

"*On the Artificial Production of Alizarine, the Colouring Substance of Madder*," by Prof. H. E. ROSCOE, F.R.S., Owen's College, Manchester.

The speaker stated that he had to bring before the notice of his audience a discovery in organic chemistry which, whether we regard its scientific interest or its practical and commercial value, is of the highest importance, and marks an era in the history of the application of chemistry to the arts and manufactures even of greater importance than the memorable discovery made by Mr. Perkin in 1856 of the production of aniline-violet, or mauve.

Since the above-named year great progress has been made in the theoretical investigation of natural and artificial colouring matters, as well as in their preparation on a large scale. The chemistry of colouring matters has now taken a high and important position, and chemists instead, as formerly was their wont, of getting rid of all colouring matters as something foreign to their objects of investigation, have, since Mr. Perkin's discovery, found out that the examination of colouring matters may not only lead to scientific laurels, but may sometimes yield fruit of another and not less acceptable kind.

We owe to the brains and hands of two German chemists, Messrs. Graebe and Liebermann, this remarkable discovery, which differs from all the former results which have been brought about by the application of science to the chemistry of colouring matters, inasmuch as this has reference to the artificial production of a natural vegetable colouring substance which has been used as a dye from time immemorial, and is still employed in enormous quantities for the production of the pink, purple, and black colours which are seen everywhere on printed calicoes, viz. alizarine, the colouring principle of madder.

It is from the liquid tarry products of the destructive distillation of coal, a rich source of interest to chemists, that we now derive this new colouring matter.

The following table contains the results of experiments made on the large scale, indicating the various yields of tar from different qualities of coal distilled in the gas-works of various towns :—

DESTRUCTIVE DISTILLATION OF COAL.

100 tons of cannel and bituminous coal distilled to yield 10,000 cubic feet of gas of sp. gr. 0·6, yield the following products :—

	Gas.	Tar.	Ammonia Water.	Coke.	
1	22·25	8·50	9·50	59·75	Average of many experiments.
2	20·01	7·85	7·14	65·00	Manchester.
3	20·40	6·40	5·40	67·85	Dukinfield.
4	21·70	7·50	5·80	65·00	Macclesfield.
5	16·30	10·70	8·00	65·00	Salford.

From a careful series of experiments made by a large tar distiller, the following numbers are derived, showing the average composition of gas tar :—

100 tons of tar on distillation yield :—

	Naphtha.	Light Oils and Carbolic Acid.	Heavy Oils, Naphthalene, Anthracene.	Pitch.	Water, Gas, and Loss.
1.	3·0	1·5	35·0	50·0	10·5
2.	3·0	0·8	25·0	60·0	12·2

It is from benzol, C_6H_6, discovered by Faraday in 1825, that the aniline colours are all of them prepared. The colour-producing power of the coal products are, however, yet far from being exhausted. It is by means of another, and hitherto comparatively unknown, hydrocarbon, anthracene, $C_{14}H_{10}$, that the newest triumphs of the chemist have been won. This is a substance which in the pure state few chemists (even yet) have seen, and upon which only two or three had previously experimented, and yet by one happy discovery—and by an investigation which more than almost any other exhibits the value of the synthetic power of modern research—this unknown body has been made to yield a colouring matter of the greatest possible value. The truth of this will at once be evident when we learn that the total growth of madder is estimated to reach 47,500 tons per annum, worth £45 per ton, and having, therefore, a value of £2,150,000. Of this nearly one-half is used in the United Kingdom, so that no less a sum than £1,000,000 is now paid by us for madder grown in foreign countries. This will now, in part at least, go to benefit our own population, as we can now transform our coal into this invaluable colouring matter.

In an experiment made on a large scale it was found that 100 tons of tar yielded 0·63 ton of anthracene, or 1 ton of anthracene can be obtained from thedistillation of about 2000 tons of coal, not reckoning the quantity of anthracene contained in the pitch.

Madder is the root of several species of Rubia, amongst which the *Rubia tinctorum* is the most valued for its dyeing properties. This grows in Holland, Asia Minor, and in the south of France and of Russia. A species native to England is the *Rubia peregrina*. This belongs to the order *Rubiaceæ*, the native members of which, as the Galiums, are mostly inconspicuous wild plants. Some of the foreign species are, on the contrary, important plants, such as the cinchona, ipecacuanha, and coffee plants, and these are distinguished for the number and variety of the peculiar principles which they yield, as quinine, cinchonine, caffeine, alizarine. Thanks to the kindness of Dr. Schunck, the speaker was able to show a young madder plant.

In spite of the many investigations which have been made of madder, chemists are still in doubt as to the nature of many of its constituents. Some attribute its colouring powers to the presence of at least two substances—alizarine and purpurine—while others say that only one of these produces the true madder colours.

Alizarine was discovered and obtained from madder, as a crystalline sublimate, by Robiquet and Colin, in 1831, but little importance attached to this discovery until Schunck, in 1848, showed that all the finest madder colours contain only alizarine combined with bases and fatty acids. The second colouring matter, termed purpurine, was discovered by Persoz. It contributes to the full and fiery red colour in ordinary madder dyeing, but dyes a bad purple, alizarine being essential to the latter. Purpurine disappears during the purifying processes of soaping, &c., being far less stable than alizarine. It is distinguished from alizarine by its solubility in boiling alum liquor.

These two colouring principles may likewise be easily distinguished by the spectrum, alizarine producing a set of dark absorption bands, quite different from those of purpurine, which again vary according to the nature of the solvent. Alizarine can be obtained in yellow needle-

shaped crystals by simple sublimation from the dried madder; but this colouring matter is, singularly enough, not contained ready formed in the fresh madder root, but is the product of a peculiar decomposition. For a proof that fresh madder does not contain alizarine we have only to extract the moist root with alcohol, when neither the alcoholic extract nor the insoluble residue will be found to possess tinctorial power. We owe this knowledge to the researches of Schunck and Higgin, who have proved that alizarine is produced by a peculiar kind of fermentation, which partly occurs in the root on standing, and and partly takes place in the dyebeck, when the powdered madder is treated with water. A crystalline glucoside, termed rubianic acid (Schunck), is contained in the root, and it is this which splits up simply into alizarine glucose. This acid crystallises in fine yellow needles, and gives a definite and crystalline potash salt, from which it was shown to contain 26 atoms of carbon in the molecule. Hence, as no other product but glucose is formed, it follows that alizarine must contain $C_{26} - C_{12} = C_{14}$. This decomposition of rubianic acid into alizarine was shown by boiling with an acid, and adding caustic soda when the blue solution of alkaline alizarine was seen. The formation of alizarine in extracts of madder root is effected by a ferment peculiar to the plant, and called erythrozym. It is a ferment *sui generis*, since no other ferment produces the same effect. When mixed with a solution of rubian or rubianic acid, at the ordinary temperature, the latter is rapidly decomposed as with acids. This is what takes place in making *fleur de garance*. Dyers raise the temperature of their madder-baths gradually up to the boiling point, because the application of a high temperature destroys the ferment. When the temperature is gradually raised, the ferment acts upon the glucoside, and produces alizarine.

That the colouring matter in fresh madder root is not alizarine can be easily shown by rubbing the soft portions of the root on to paper, when a yellow stain will be produced, which, on treatment with an alkali, shows the bright red colour of an alkaline solution of rubian instead of the blue solution of alizarate.

According to Schunck, the origin of purpurine, and its relation to alizarine, are still involved in obscurity.

The hypothesis which of late years has done more than any other to stimulate experiment and enlarge our views in organic chemistry is undoubtedly Kekulé's theory of the tetrad nature of carbon and his explanation of the constitution of the carbon compounds. In the so-called paraffine group of organic substances, the carbon atoms are supposed to be connected together by single links of the four bonds attached to each atom, thus giving rise to saturated compounds by the attachment of other elements or radicals to the free bonds. In the group of aromatic substances with which we are specially concerned the carbon atoms are more closely linked together, or, in other words, a less number of atoms of hydrogen are necessary to saturate an aggregation of carbon atoms than is the case in the other group. We can explain this, upon the assumption of the tetrad character of carbon, by supposing that each carbon atom is attached to its neighbour alternately by one and by two bonds.

Another singular property of these aromatic bodies is that they all contain at least six atoms of carbon, and that the simplest hydrocarbon of which they are made up is benzol, C_6H_6. So that we may regard all these aromatic compounds as benzol derivatives, and this hydrocarbon may be considered as the skeleton round which many complicated substances are arranged. So that by the replacement of one atom of hydrogen by NH_2, we obtain aniline, by OH phenol, &c. From the knowledge gained by his investigation on the quinones, Graebe came to the conclusion that alizarine belongs to the quinone series; and, availing themselves of Baeyer's reaction, by which phenol can be converted into its hydrocarbon, benzol, Graebe and Liebermann passed the vapour of natural alizarine obtained from madder over heated zinc-dust, and found that the hydrocarbon they formed was identical in all its properties with anthracene, $C_{14}H_{10}$, from coal tar. Hence they confirmed Schunck's conclusions that the molecule of alizarine contains fourteen atoms of carbon. Having thus got hold of the backbone, as it were, of the compound, it only remained for them to clothe the hydrocarbon with the four additional atoms of oxygen and to take off the two atoms of hydrogen in excess, in order to obtain alizarine.

Laurent and also Anderson had, many years ago, obtained a body of the composition $C_{14}H_8O_2$, and Graebe recognised this as the quinone of anthracene; and he now only required to replace in this two atoms of hydrogen by two of hydroxyl (OH), in order to obtain alizarine, which clearly appeared to be a quinone acid—

$C_{14}H_{10}$	$C_{14}H_8(O'')_2$	$C_{14}H_6\begin{cases}O_2''\\OH\\OH\end{cases}$
Anthracene.	Anthraquinone.	Alizarine.

This replacement of hydroxyl can be effected by bromine, by which bibromanthraquinone $C_{14}H_6Br_2O_2$ is formed, and this, on fusion with caustic potash, gives potassium alizarate, yielding pure alizarine on treatment with hydrochloric acid. The high price of bromine rendered this process unavailable for manufacturing purposes, and hence another plan was simultaneously proposed by several chemists for effecting the same end in a cheaper mode. Use was hereby made of Kekulé's and Wurtz's reaction in the formation of sulpho-benzolic acid. On treating anthraquinone with strong sulphuric acid to a high temperature, the di-sulpho acid—

$$C_{14}H_6O_2\begin{cases}SO_3H\\SO_3H\end{cases}$$

is formed, and this on heating with concentrated solution of potash, yields the sulphite and alizarate of potassium; from the latter substance pure alizarine is obtained by the action of acids.

In the following table we have a statement of the synthetic production of alizarine from its constituent elements.

SYNTHESIS OF ALIZARINE.

1. Acetylene by direct union of carbon and hydrogen in electric arc.
$$C_2 + H_2 = C_2H_2 \quad \text{(Berthelot, 1862.)}$$
2. Benzol (tri-acetylene) from acetylene by heat.
$$3C_2H_2 = C_6H_6 \quad \text{(Berthelot, 1866.)}$$
3. Anthracene from benzol and ethylene.
$$2C_6H_6 + C_2H_4 = C_{14}H_{10} + 3H_2 \quad \text{(Berthelot, 1866.)}$$
4. Alizarine from anthracene. (Process No. 1.)
(Graebe and Liebermann, 1869.)
   (A) Oxyanthracene or anthraquinone by nitric acid.
   $C_{14}H_6(OH)_2$ (Anderson, 1861.
   (B) Bibromanthraquinone by action of bromine.
   $$C_{14}H_8O_2 + 2Br_2 = C_{14}H_6Br_2O_2 + 2BrH$$
   (C) Alizarine by action of caustic potash.
   $$C_{14}H_6Br_2O_2 = 4KHO = C_{14}H_6(OK)_2O_2 + 2KBr + 2H_2O$$
   Potassium alizarate.
5. Alizarine from anthracene. (Process No. 2.)
(Graebe and Caro, Perkin, Schorlemmer, and Dale.
   (A) Disulphoanthraquinonic acid from anthraquinone.
   $$C_{14}H_6(OH)_2 + 2H_2SO_4 = C_{14}H_6O_2\begin{Bmatrix}SO_3H\\SO_3H\end{Bmatrix} + 2H_2O$$
   (B) Alizarine from the above by the action of potash.
   $$C_{14}H_6O_2\begin{Bmatrix}SO_3H\\SO_3H\end{Bmatrix} + 4KHO =$$
   $$= C_{14}H_6O_2\begin{Bmatrix}OH\\OH\end{Bmatrix} + 2K_2SO_3 + 2H_2O$$
   Alizarine.

Mr. Perkin states that an intermediate substance is formed in this reaction having the formula—

$$C_{14}H_6(O)_2''\begin{cases}OK\\OSO_3\end{cases}$$

and this, when heated with potash, splits up into alizarine and a sulphite. Other yellow-coloured products are, according to Perkin, contained in the alizarine as sent out from his manufactory. The nature of these yellow crystalline bodies is as yet unknown.

Of the identity of the natural with the artificial alizarine there can be no doubt: they agree in all their physical and chemical properties. Their absorption spectra are identical, their tinctorial powers are the same; the coloured lakes which they form with alumina, iron, and copper salts, are of the same tint, and possess the same degree of solubility, and these remain alike unaltered by the action of light, so that when they are fixed in the cotton-fibre they yield equally fast colours.

It is difficult to predict how far the artificial alizarine will in future restrict the growth of madder; but there is no doubt that for many styles of calico-printing the artificial alizarine is of the greatest value, and we may naturally expect to see very important changes effected in this branch of chemical industry in the further practical application of this new discovery.

Contributions to the History of Alizarine. $C_{14}H_8O_4$.

1825. Faraday discovered benzol in coal-gas oil. C_6H_6.
1831. Robiquet and Colin discovered alizarine in madder root.
1832. Dumas and Laurent discovered anthracene in in coal oils.
1848. Schunck gave the composition of alizarine, $C_{14}H_{10}O_4$.
1850. Strecker gave the composition of alizarine, $C_{10}H_6O_3$.
1862. Anderson examined anthracene compounds, $C_{14}H_{10}$.
1865. Kekulé explained the constitution of the aromatic compounds.
1866. Baeyer obtained benzol from phenol.
1868. Graebe investigated the quinones.
1868. Graebe and Liebermann obtained anthracene from alizarine.
1869. Graebe and Liebermann obtained alizarine from anthracene.

NOTICES OF BOOKS.

First Report of the Commissioners Appointed in 1868 *to Inquire into the Best Means of Preventing the Pollution of Rivers. (Mersey and Ribble Basins.)* Vol. i. 1870.*

(Continued from p. 176.)

TURNING our attention now to the remedies proposed, we find the following in respect of the purification of sewage, treated under the three heads of—Treatment with Chemicals; Filtration; and Irrigation. The first of these is alluded to as follows:—

"*Purification of Sewage by Chemical Agents.*—The valuable constituents of sewage present to the chemist a mine of wealth, which, despite so many failures, has constantly stimulated him to renewed efforts for their extraction in a portable, and consequently marketable, form.

"The chief valuable ingredients of sewage are, first, the different forms of combined nitrogen; and, second, phosphoric acid. The money-value of these constituents *dissolved* in 100 tons of average sewage is about 15s., whilst the *suspended matters* contain only about 2s. worth of them.

"There is but little difficulty in extracting the suspended matters by filtration, but, as these do not contain quite one-seventh of the total valuable constituents, the process, though simple, has never been remunerative; and, inasmuch as it still leaves much putrescible organic matter in solution, the mere extraction of the suspended matters of sewage, although doubtless tending to mitigate nuisance, does not produce any substantial diminution of the polluting quality of the liquid. The operations of the chemist have therefore been directed chiefly to the soluble constituents of sewage; and have had for their object, either the precipitation in a solid form of the valuable, but offensive, ingredients, so as to convert them into portable manure, or, secondly, the rendering them inoffensive by the action of disinfectants. Although these operations have not been altogether unsuccessful, they have hitherto entirely failed in purifying average sewage to such an extent as to render it admissible into running water. We have formed this opinion both from observations of the polluting effect of such chemically-purified sewage upon the streams into which it was admitted, and from the amount of putrescible organic matter revealed by the chemical analysis of the sewage after treatment.

"The following is a description of those processes belonging to the chemical category which we have witnessed in operation:—

"(*a*). *Treatment with Lime.*—This process was doubtless first suggested by the ingenious operation devised by the late Dr. Clarke, of Aberdeen, for softening certain hard waters. It has been applied to sewage upon an extensive scale, at Tottenham, for the manufacture of "Tottenham sewage guano;" at Blackburn, and especially at Leicester, in the production of the so-called "Leicester bricks" (the name under which the manure was sold). In all these places, the plan has been a conspicuous failure, whether as regards the manufacture of valuable manure, or the purification of the offensive liquid.

"We have witnessed the process at Blackburn, and on two occasions at Leicester, where it is still used, the machinery employed at the latter place being very perfect and efficient.

"At both places the method obviously failed in the purification of the sewage to such an extent as to render it admissible into a river. At Blackburn especially the river below the outlet of the limed sewage was in a most offensive condition of putrefaction, our note made at the time of our visit being as follows:—'Horribly offensive, turbid, blackish stream, disengaging most offensive gases, with black masses of putrid mud floating on the surface.'

"The operation is exceedingly simple, and, as carried out at Leicester, consists in mixing with the sewage, as it arrives at the works, a certain proportion of milk of lime. The mixture is then violently agitated by appropriate machinery on its way to large reservoirs of subsidence, in which a copious deposit of highly-putrescible mud takes place, whilst the supernatant liquid flows off in a comparatively clear, though still somewhat milky, condition. The floors of the reservoirs of subsidence slope from two opposite sides towards the centre, where there is a gutter, from which a Jacob's-ladder elevates the slush into a shoot, through which it is conveyed to pits, where it slowly dries, partly by evaporation and partly by soakage into the surrounding soil.

"(*b*). *Treatment by Sillar's Patent or "A.B.C." Process.*—The specification of this process is given by the patentees, Messrs. W. C. and R. G. Sillar and W. G. Wigner, as follows:—

"'We add to the sewage to be purified a mixture consisting of the following ingredients:—Alum; blood; clay; magnesia or one of its compounds (by preference the carbonate or the sulphate); manganate of potash or other compound of manganese; burnt clay, otherwise known as ballast; chloride of sodium; animal charcoal; vegetable charcoal; and magnesian limestone. Of these substances, the manganese compound, the burnt clay, chloride of sodium, and magnesian limestone, may be omitted; and it is not essential that both animal and vegetable charcoal should be used. If any of the ingredients named should from any cause be present in sufficient quantity in the sewage, it may of course be omitted from the mixture. The proportions in which the ingredients are to be used

vary according to the nature of the sewage to be purified—as, for instance, if a large proportion of urine is present, we increase the proportion of clay; if the sewage is much diluted, we slightly increase the proportion of alum and blood; if it contains a large proportion of street-refuse, we decrease the proportion of clay.

"'For ordinary sewage, the following proportions have answered well:—

Alum	600 parts
Blood	1 ,,
Clay	1900 ,,
Magnesia	5 ,,
Manganate of potash ..	10 ,,
Burnt clay	25 ,,
Chloride of sodium	10 ,,
Animal charcoal	15 ,,
Vegetable charcoal	20 ,,
Magnesian limestone ..	2 ,,

"'These substances are mixed together, and added to the sewage to be purified until a further addition produces no further precipitate. The quantity required will be about 4 lbs. of the mixture to 1000 gallons of sewage. In many cases, it is preferable to mix the above compound with a small quantity of water, and add it in a liquid state to the sewage. The sewage must then be thoroughly mixed with the compound, and allowed to flow into settling-tanks. The greater part of the organic and other impurities will be immediately separated in the form of large flakes, which rapidly fall to the bottom, leaving the supernatant water clear and inodorous, or nearly so. The water may then be allowed to flow away into a river, or be disposed of in any other way, and the sediment or mud allowed to accumulate at the bottom of the tank. In some cases, it is preferable to add the compound of manganese to the water after the sediment produced by the other ingredients has been allowed to subside. The sediment will be found to possess the power of precipitating a further quantity of sewage; it must therefore be pumped or otherwise taken from the tank, and mixed with fresh sewage, the sediment being allowed to subside in the same way as before. The sediment may be used five or six times over in this way. When the sediment no longer possesses the power of precipitating the impurities in the sewage, it must be removed from the tank, and allowed to dry. When partially dry, a small quantity of acid (by preference sulphuric acid) may be mixed with it, which will retain all the ammonia in a soluble form. When dried, the sediment will be a valuable manure.'"

Speaking of this process the Commissioners say that, "Notwithstanding the loss of nitrogenous organic matter in the process of deodorisation, the 'A.B.C.' method of treatment still yields a solid manure of much greater value than that obtained by the lime process—a circumstance which is explained, to a great extent, by the acidity of the mud from the former process, and the alkalinity of that from the latter. The lime mud thus loses ammonia in drying, whilst the other, especially if still further acidified, cannot suffer this loss."

The analysis of the mud shows that "In the three valuable constituents of manure, viz., in ammonia, in other forms of combined nitrogen, and in phosphoric acid, the manure obtained by Sillar's process is greatly superior to that resulting from the treatment with lime. Unfortunately, some doubt is thrown upon the source of the increased amount of phosphoric acid present in the manure obtained by the former process, because bone-black, in, to us, unknown quantity, entered into the composition of the precipitating material used, and thus an uncertain amount of phosphoric acid was added to that which was actually derived from the sewage."

The results of their experiments on the Sillar and lime processes are summarised as follows:—

"1. The 'Sillar' and lime processes remove to a great and nearly equal extent the suspended matters contained in sewage.

"2. Sillar's process increases the amount of dissolved solid matters in sewage, but reduces the quantity of putrescible organic matter. The lime process reduces both the amount of dissolved solid substances and the quantity of putrescible organic matter; the reduction of the last being about the same as that effected by Sillar's process, viz., rather more than one-half.

"3. Both processes fail in purifying sewage to such an extent as to render it admissible into running water."

"4. For the mauufacture of solid manure from sewage, Sillar's process is greatly superior to the method of treatment by lime, although it fails to extract from the liquid more than a very small fraction of its valuable constituents."

The treatment by lime and chloride of iron is described as follows:—

"At Northampton, this process is applied to the sewage of 40,000 people. 4400 houses are here connected with the drains, and 2800 are undrained. The excellent and constant water supply of 600,000 gallons daily, or 15 gallons per head, is derived chiefly from deep wells in the oolite. The sewage works are situated about half a mile from the town. Each million gallons of sewage is here mixed with 12 bushels of lime and about 6 gallons of chloride of iron (in hot weather more; in cold weather less). The lime is added first, and then the chloride of iron. The defecated sewage is afterwards submitted to upward filtration through a stratum of calcined iron-ore 8 inches thick; but we consider that, beyond the separation of suspended matters, which would be equally effected by subsidence, this latter operation is nearly useless. The effluent sewage, after a flow of 1¼ miles through a culvert, in which it becomes mixed with about one-sixth of its volume of spring water, is discharged into the river Nen, in a nearly clear and apparently innocuous condition. We examined the stream for about one-third of a mile below the outfall, and could perceive no sewer-fungus or other sign of sewage pollution. Nevertheless, analysis shows that the sewage discharged into the stream still contains in solution a large amount of putrescible organic matter; but the putrescence of this matter was doubtless delayed, by the chloride of iron used in the treatment, until the stream had flowed beyond the point where we examined it. It is well known that chloride of iron possesses this property in a very remarkable degree;* but the putrefaction of the disinfected sewage is only delayed, and not ultimately prevented. In fact, the river Nen does eventually become putrid in consequence of the discharge into it of the Northampton sewage; and an injunction has been granted by the Court of Chancery restraining the Improvement Commissioners from discharging the sewage of the town into the river after June 1st, 1870.

"The chloride of iron in solution is manufactured on the premises, at a cost of £6 per ton. A sample of it which we brought away with us contained, in 100,000 parts:—

Iron as perchloride	4413·7
,, protochloride	9124·3
Total iron	13538·0

"*Treatment with Crude Sulphate of Alumina, and subsequent Filtration through Coke.*—This process, which is known as Bird's, is carried out at Stroud, in Gloucestershire. From 150,000 to 200,000 gallons of sewage are daily treated with 6 cwts. of pulverised clay, to which 120 lbs. of sulphuric acid have been added some days previously. The sewage is made to turn a small water-wheel which regulates the delivery from a hopper of the sulphated clay or crude sulphate of alumina, which falls into the stream of sewage on its passage to a settling-

* Report on the Deodorisation of Sewage, by Hofmann and Frankland, presented to the Metropolitan Board of Works, August 12th, 1859.

tank, whence it flows under a second hopper, from which it receives a second dose of the sulphated clay. Thence it flows into a depositing-tank, and afterwards through three coke filters. The coke is renewed in the first filter every fortnight, and in the last every month. The foul coke is burnt under the boiler.

The condensed results of purification of sewage are expressed, as far as chemical processes are concerned, in the following brief tabulated form:—

Chemical processes.	Average percentage of dissolved organic pollution removed.		Average percentage of suspended organic pollution removed.
	Organic carbon.	Organic nitrogen.	
Best result	50·1 ..	65·8 ..	100·0
Worst result	3·4 ..	— ..	59·6
Average result ..	28·4 ..	36·6 ..	89·8

The sections on the purification of rivers from the liquid refuse from manufactories, and that on water-supply, however interesting, are of too local an interest, in this instance, to call for condensation or for an abbreviated account here. The recommendations of the Commissioners are worthy of our notice, and we therefore quote these in full, with the observation, however, that nobody acquainted with what is really meant by, and included in, the term *police*, taken in the scientific sense, can fail to see that the want of sufficient centralisation and power of control given to the Secretary of State for the Home Department, as *ministre de l'interieur* over all municipal and local authorities, where and whatsoever they be, is at the bottom of the state of matters, caused by ignorant neglect, as well as foul selfishness, and described in these pages. What is absolutely wanted is a strongly and well organised *administration de la sûreté et de la salubrité publique*. As understood and carried out abroad, *Salus populi suprema lex esto*.

"1. That the casting of any solid matters, of whatever kind, into rivers and running waters, or the placing of solid refuse in such positions on the banks of rivers as to render it liable to be washed away by floods, be absolutely prohibited under adequate penalties; and that any act passed for this purpose be made to take effect immediately.

"2. That the discharge of any polluting liquids, such as those defined in the conclusions to this Report, into any river or stream, from any sewer or other outlet, reservoir, tank, or vat, be prohibited under adequate penalties; but that, after the passing of any act prohibiting the admission of polluting liquids into running water, a reasonable time be allowed to corporations, local boards, manufacturers, and others, for the execution of the necessary works for purification.

"3. That all rivers and streams in England be placed under the superintendence of a central authority or board, to be composed of not more than three persons, who shall be duly qualified to deal with all questions connected with the pollution of water and with water-supply.

"4. That it be the duty of this board to see that all enactments relating to the use or abuse of running water be duly enforced; and that, for this purpose, power be given to it to inspect manufactories, reservoirs, sewerage, and other similar works, and to cause to be constructed, at the expense of the owners of the same, whether corporate or private, any necessary purifying-apparatus, in case the said owners neglect or refuse to provide such apparatus for themselves.

"5. That, subject to proper regulations to prevent abuse, additional powers be given to corporations, local boards, manufacturers, and others, to take land compulsorily, under "Provisional Order," for the purpose of cleansing sewage or other foul liquids, either by irrigation, filtration, or otherwise, and to obtain, if required, easements for the construction of culverts and outfalls for drainage through private property, making compensation only for damage actually done, reserving, however, to the owner the right at any time afterwards, if he could show further damage, to have further compensation.

"6. That it be the duty of the central board to exercise a surveillance over both the quality and quantity of the water-supply of towns; to carefully guard domestic supply from contamination, or, if it be already contaminated, to ascertain the source or sources of injury, and to cause the same to be removed.

"7. That it be the duty of this central board to investigate all schemes for water-supply; and also all proposals for public works connected with river-conservancy, whether initiated by local authorities or by any principal conservancy board of a river-basin either now in existence or to be hereafter constituted; and to report thereon to one of Your Majesty's Principal Secretaries of State."

Our space forbids us to make further extracts from this full and comprehensive report, but we cordially recommend its perusal to all interested in the question. As stated in the prefatory remarks, the report refers to the subject of river conservancy generally as well as to the condition of the particular river basins to which it is professedly confined. The Commission could not have included a more able and earnest worker than Dr. Frankland, and our thanks are due to him and his brother Commissioners, Sir W. J. Denison and Mr. J. C. Morton, for the great scientific skill they have brought to bear on this difficult subject.

CORRESPONDENCE.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

Sir,—I think it due to Mr. Hofmann, while acknowledging him as the originator of what I expect will become an immense improvement in the manufacture of sulphuric acid, and expressing my thanks for his liberality in freely giving his invention to the chemical world, to give him, and all who feel interested in the matter, my experience in working out Mr. Hofmann's plan with what I still consider my slight improvements in the *modus operandi*.

I am under the necessity of keeping all my chambers at work while gradually making my arrangements for the new mode, as I require the equivalent of 90 to 100 tons of acid of 1·845 out of them weekly; I am, therefore, only partially at work on the new plan, but so far with most encouraging success.

When I commenced operations my consumption of nitrate of soda was exactly 4 tons 2 cwts. weekly. I have reduced down to 3 tons, and my acid is still of good colour, showing sufficient nitre, and last week my production was rather over my average.

I am now preparing for throwing all the SO_2 from my whole series of furnaces into No. 1, and shall then work Nos. 2 and 3, as I am now doing, at 1·715, and without steam; and all the acid from these two chambers, loaded with nitrous fumes, goes back into No. 1, where, mixing with the hot acid of about 1·5, produced by No. 1, into which steam is thrown in large volume, the nitrous acid is evolved and again becomes available, and so is brought back to its work by a process which makes it theoretically almost impossible for it to escape, although practically there must always be a considerable loss. This regular return of the nitrous acid to the first chamber, Mr. Hofmann will, I think, allow to be an improvement on his theory.

I think I see my way to working with 2 tons nitrate instead of 4 tons 2 cwts.—I am, &c.,

P. Spence.

MISCELLANEOUS.

New Magnesia Burner.—During a visit which we lately made to the works of the New York Oxygen Gas Co., 547, West 41st Street, we saw a new burner in operation which had just been received from France, and which successfully meets the difficulty previously found in burning the oxygen light, with a very low pressure on the "burning-gas." Each elementary burner consists of three very minute jets, two at either side coming somewhat towards each other, which are supplied with the ordinary gas, and the other between them, and a little shorter, which is fed with oxygen. By this means, no matter how low the pressure on the illuminating-gas may be, no retreat of the flame into the jet can occur. We saw this burner, in fact, operating most excellently with a pressure of about 2-10th inch of water. We hear from Mr. C. H. Stoddard, that a yet further improvement is announced, of which specimens will soon be on hand.—*Communicated by Professor Morton.*

Use of Calcium Lights at the Saint Louis Bridge.—From Mr. W. Milnor Roberts, who is in charge of the work, we hear as follows:—"We have used calcium lights only for our open-air work in laying masonry on the top of our caissons—one light on one side, and one at the other, on diagonal corners: we found that they distributed the best light when thus placed. We had the oxygen gas forced into copper gas-holders with a pressure of about 200 lbs. to the square inch. These were carried over from the City to the piers on a little steamer, and the gas was conveyed to the burner through small lead pipe. At first our reflectors were of glass, but so many were broken that they were replaced by metal. A man remained with the two burners through the night, to regulate them occasionally, and to mend the pipes when a burst occurred. They usually burn from eleven to twelve hours; and, with the aid of some movable large reflector lamps, the masons worked as well at night as in the day. The cost of the calcium lights to our company was 3·75 dollars per hour each."—*Communicated by Professor Morton.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, April 11, 1870.

This rather small number is chiefly taken up by papers relating to phyto- and zoo-physiology. The papers and memoirs relating to chemistry and collateral sciences are the following:—

Correction of the Name of a Late Very Celebrated Man.—Marshal Vaillant deposits several authentic records, from which it appears that the famous natural-historian, Cuvier, was born on August 23, 1769, at Montbéliard, and his birth registered with the Christian names of Jean Léopold Nicolas Frédéric. The Christian name of Georges, by which, while living, this eminent man was known, is not on the official registers.

Action of Magnetism upon Two Electric Currents which are Made to Pass simultaneously through Space Containing Rarefied Gases.—L. Daniel.

Experiments Made with the View to Elucidate the History of Nitric Acid.—E. Bourgoin.—The author's experiments, described at length, prove that by the reducing action of hydrogen upon nitric acid, $NO_5 2H_2O_2$, there are formed nitrous acid, deutoxide of nitrogen, nitrogen, and ammonia.

Metallic Tartrates.—M. Descamps.—The only tartrate described is the double tartrate of sesquioxide of manganese and potassa, $Mn_2O_3.KO,C_8H_4O_{10},4HO$. This salt is obtained by pouring a concentrated solution of bitartrate of potassa, at a temperature of 40°, upon sesquioxide, or, better yet, hydrated binoxide, of manganese; the vessel wherein this operation is carried on should be cooled. The reaction results in the production of a deep red-coloured liquid, which deposits, after filtration and some days' standing, red-coloured crystals of the double salt; the solution referred to is readily decomposed by the action of heat. Even at as low a temperature as 50° or 60° this decomposition begins, but at a higher temperature it becomes violent and instantaneous, being accompanied by a sudden evolution of oxygen; the liquid then becomes colourless, and only contains a salt of the protoxide of manganese. The red-coloured solution is neither precipitated by caustic nor carbonated alkalies; all reducing agents decompose this solution, and the decomposition is accompanied by decolouration of the liquid.

Aurora Borealis.—This number contains a valuable series of communications concerning an aurora borealis, observed on the 5th of April in various parts of France and Belgium, over a surface of country stretching from the sea eastward to the Rhine, and from Louvain, Leuven (Belgium), in the north, to no less a distance south than Annecy, in Savoy, the latter being a distance about equal to that from London to Edinburgh.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2, 1870.

This number contains the following original papers and memoirs:—

Zirconium.—B. Franz.—The author describes first at some length the preparation of pure zirconia on a somewhat large scale by treating the native mineral with bisulphate of potassa, and the decomposition of the sulphate of zirconia, first by fusion with caustic soda, and next by treating the fused mass so obtained with sulphuric acid, and precipitating the zirconia from the aqueous solution of the sulphate by means of ammonia. Metallic zirconium was prepared by the decomposition of the fluoride of potassium and zirconium, $3KFl+ZrFl_4$, by means of aluminium and a high temperature. The metallic zirconium so obtained is not quite pure, and was found to consist, in 100 parts, of:—Zirconium, 98·34; aluminium, 1·03; and silicium, 0·17. The temperature required for this reduction so as to obtain crystalline zirconium is at least as high as that of the melting-point of copper.

Expansion of Water (Lecture Experiment).—F. Rüdorff.—In order to exhibit the effect of the expansion of water when freezing, the author fills with distilled and previously well-boiled and cooled water a cast-iron cylinder having the following dimensions:—Height, 160 m.m.; diameter (external), 50 m.m.; thickness of solid iron, 15 m.m. After having been filled with water this apparatus is closed by means of a plug screwed into the neck, and the cylinder is next placed in a mixture of 3 parts of snow or pounded ice, and 1 part of common salt; after about 40 minutes the cylinder bursts with a loud report. It is essential for the success of this experiment that the plug fits very perfectly, and that the cylinder, after having been filled with water, be placed for some time in ice. The wooden pail which contains the cooling mixture should be rather roomy, and be covered with a stout towel to prevent the spirting about of the contents at the time of the bursting.

Preservation of Zoological and Anatomical Preparations in Creosote-Water.—F. Holbein.—The main point of interest in this paper is that specimens collected during journeys may, after having been kept immersed for a shorter or longer time in creosote-water to be made extempore, be dried and packed as if they were minerals.

Mesohydromellitic and Tetrahydrophthalic Acids.—A. Baeyer.—Mesohydromellitic acid is difficultly soluble in cold, but readily so in boiling, water; it is a solid crystalline substance; at 130° it looses two equivalents of water, and becomes anhydride of mesohydromellitic acid, $C_{18}H_8O_{10}$. Tetrahydrophthalic acid fuses at 95°; the author states that he is engaged in further researches on this subject. This paper contains a series of very complicate formulæ which serve to illustrate the constitution of the bodies alluded to, but space forbids us to re-produce these formulæ here.

Withdrawal of Water (Wasserentziehung), and its Bearing upon Vegetable Life and Fermentation.—A. Baeyer.—This lengthy paper is divided into the following main sections:—Anhydride formation; condensation; phenomena of fermentation.

Products obtained from Crude Malt Spirits by Distillation.—G. Krämer and A. Pinner.—The authors first refer to some former researches on this subject, reminding that raw or crude spirits (a rather strong alcohol is alluded to) contains large quantities of aldehyde acetal, and croton aldehyde; and they have further discovered, in the so-called fusel oil, isobutyl alcohol, ethyl alcohol, and propyl alcohol.

Vapour Density of Acetic Acid.—A. Horstmann.—This paper is not suitable for abstraction. It contains a series of algebraic formulæ and tabulated results of the vapour density of the acid referred to from 12·4° to 63·1°.

Solid Bisulphide of Carbon.—Dr. V. Wartha.—Already referred to by us (see CHEMICAL NEWS, vol. xxi., p. 131).

New Locality where Diamonds have been Discovered.—G. Rose.—The author refers to the diamond found at Dlaschkowitz, a village in Bohemia. The facts are known to our readers from the abstracts from the *Comptes Rendus* for this year.

Cause of the Emission of Light by Phosphorus.—W. Müller.—This very lengthy memoir treats on the question, whether the emission of light by phosphorus is due to its oxidation, or whether

it is caused by its volatilisation. A lengthy series of experiments is minutely described; and the main result arrived at is, that, since phosphorus is not oxidised by oxygen under normal conditions, and its emission of light increased by withdrawal of the pressure of air, it would appear that the luminosity of this substance is in some way connected with its volatilisation.

On Tetraphenol, C_4H_4O.—H. Limpricht.—This substance was obtained by the distillation of an intimate mixture of pyromucate of barium and 0·9 parts of soda lime. Tetraphenol is a colourless liquid, insoluble in water, boiling at 32°, and evaporating so rapidly at ordinary temperature, that a portion of a drop on a glass rod is solidified by the cold produced by the evaporation of the rest.

Use of Hypobromite of Baryta as a Reagent.—W. Knop.—This paper treats on the use of the hypobromite of baryta for the detection of ammonia, but the author's experiments on this subject are not quite complete as yet.

Cosmos, April 9, 1870.

Causes of Steam-Boiler Explosions.—J. Georges.—This author, a mechanical engineer and boiler-maker, states that his experience has taught him that the bursting and exploding of steam-boilers is chiefly due to defects in the iron plates used in the construction of these apparatus; and his proposal is, that, instead of testing boilers under pressure, as is usual, by means of hydraulic appliances, the plates should be tested at the iron-works, and stamped by the *garde-mine*, if found of sufficiently good quality for use for the construction of boilers. (The *garde-mine* is, in France, an official who might be termed, in English, a viewer of mines; but his education, practical as well as theoretical, is far more extensive, and under the Ingénieurs des Mines for each district; the supervision of stationary steam boilers, and of all manufactories connected with mining and metallurgical operations, is also confided to him.)

Laboratory Accident.—A short time ago, the inmates of the Hôtel-Dieu were greatly disturbed by a severe explosion, which shook the large building. On ascertaining the cause, it was found that the chemical laboratory of that establishment was the scene of the disaster; and among the heap of ruins into which this place was converted was found the almost lifeless body of a young student, who had repaired to the laboratory for making some preparation of oxygen (so the French text reads). As he was severely wounded and quite unconscious, the cause of the explosion has not been ascertained. As a matter of course, the whole place was in flames also; but the *pompiers* on duty at the Hôtel de Ville succeeded in quenching the flames in a few minutes, by the aid of the hydrants in the building.

Imperial Agricultural College.—On the 1st of July next will be inaugurated another of these establishments, which have proved highly useful. The College here alluded to will be the first of the kind in the southern parts of France, and be established close to the city of Montpellier, where a site of some 25 hectares (about 62 acres) of land has been allotted for the purpose.

April 16, 1870.

Decimal System of Weights and Measures.—We learn that the two Representative Assemblies of the Kingdom of Wurtemberg have unanimously approved of the proposition made by the Ministry, as regards the adoption in that Kingdom of the decimal system of weights and measures, which becomes compulsory also for coinage from the first of January, 1872.

Nature of the Sun.—G. Bernaerts.—The first instalment of a rather lengthy, yet very interesting, paper on this matter, wherein is compiled all recent researches on this subject.

Increase of the Number of Inhabitants of Large Cities and Towns.—Although not belonging to the subjects generally treated in our paper, we may not omit to mention an astonishing fact. Leaving other particulars, we only quote that whereas, in the year 1832, Berlin was, in relation to the number of its inhabitants, the eighth in the order of the European capitals, it is now the third; its population in 1832 was 250,000, and in 1869 (end of year) it was 800,000, an increase at the rate of 220 per cent. Of all the capitals of Europe, the increase of population of Amsterdam during that time was the smallest, being only at the rate of 12 per cent. The next largest percentical increase o Berlin is that of Liverpool, at the rate of 174 per cent.

Les Mondes, April 7, 1870.

Foundation of a Chair of the History of Medicine and Surgery at the Medical Faculty of Paris.—Since authorisation has been received to accept the legacy of £6000 bequeathed by M. Salmon de Champorean for the foundation of the chair above named, there will be shortly an election of a properly qualified lecturer for this office.

National Congress for Geographic, Cosmographic, and Commercial Sciences, at Antwerp.—During the month of August next, there will be a meeting at the city alluded to, and among the principal subjects for discussion are—The astronomical past and future of our globe, its own heat and its cooling down; is it possible to draw, from the laws which rule these phenomena, conclusions relating to the economy of fuel, and to the influence which the hand of man has brought about by the draining of marsh-grounds and lakes, the cultivation of forest on mountains and plains, the formation of inland seas, &c.; adoption of the same *first* meridian; adoption of the same system of measures for use in daily life, as well as for scientific use; anthropology, in its relation to geography. Among the desirable works to be executed in the interest of all the civilised nations of the world, the congress desires discussion on the piercing of the Isthmus of Panama; railway towards Persia and India along the Euphrates valley, and conversion of the Desert of Sahara into an inland sea. There will be held at Antwerp, during the meeting, an exhibition of objects relating to geography, ethnography, and commerce.

Black Snow.—M. Feltz.—The author, who resides at Arlovetz Russia, states that, during a severe gale of wind from the north-east accompanied by a snow-storm, there fell, on the 31st of January last, between 2 and 4 p.m., a quantity of a blackish coloured substance, strongly contrasting with the peculiar brightness of the previously-fallen snow. On examining this powdery substance more particularly, it was ascertained to be arable soil, which, as was afterwards learnt, had been carried by the violence of the wind for a distance of many miles. The quantity of this soil, dried at 100°, was found to be 6·5 grms. for a surface of a square metre; and, since it was found that, at the very least, a surface of 10 square kilometres (3·86 English square miles) had been covered to the same extent with this dust, the quantity thereof carried by the violence of the wind amounted to at least 650,000 kilos. = 650 tons' weight.

Foundation of a Laboratory for Medical Chemistry.—Dr. G. Le Bon.—In imitation of what has been successfully accomplished in Germany, the author has established a laboratory for the special purposes of testing, analysing, and experimenting in physiological and pathological chemistry, in connection with microscopical observations and other requirements of modern medical science.

April 14, 1870.

Cerebral Activity, and the Relation the Composition of Urine bears thereto.—Dr. Byasson.—According to a series of accurately-made experiments, the author having himself been the subject of such trial, he states that cerebral activity is accompanied by a more abundant production of urea, and alkaline phosphates and sulphates; while muscular activity is accompanied by the increased production of urea, uric acid, and chloride of sodium. The author's full researches are recorded in his inaugural thesis, sustained before the medical faculty at Montpellier.

Revue des Cours Scientifiques de la France et de l'Etranger, Nos. 19 and 20, 1870.

Neither of these numbers contain any original papers relating to chemistry; the last-named contains an excellent and full account of a lecture on the—

History and General Properties of Blood.—Claude Bernard.—This lengthy paper treats on this most important subject, commencing from the earliest days of existing written records, and fully entering into physiological as well as chemical details.

Annalen der Chemie und Pharmacie, March, 1870.

This number contains the following original papers and memoirs:—

Chemical Nature of the Xylol contained in Coal-Tar.—R Fittig.—The gist of this very lengthy paper is that xylol, whether obtained from coal-tar or from other sources, is a mixture of various bodies.

On Isophthalic Acid and some of its Derivatives.—H. E. Storrs and R. Fittig.—The authors describe:—Isophthalic-acid ethyl ether—

$$C_6H_4\begin{cases}CO(C_2H_5)O\\CO(C_2H_5)O\end{cases};$$

Nitro-isophthalic acid—

$$C_6H_3(NO_2)\begin{cases}COHO\\COHO\end{cases};$$

Nitro-isophthalate of calcium and barium; nitro-isophthalic-acid ethyl ether, $C_6H_3(NO_2)O_4.(C_2H_5)_2$; amido-isophthalic acid—

$$C_6H_3(NH_2)\begin{cases}COHO\\COHO\end{cases};$$

Hydrochloro-amido-isophthalic acid, $C_6H_3(NH_2)O_4.HCl+H_2O$; sulphuric-amido-isophthalic acid, $[C_6H_3(NH_2)O_4]_2H_2SO_4$.

On Amido-dicyanic Acid.—F. Hallwachs.—This memoir is divided into the following sections:—Preparation of amido-dicyanic acid; amido-dicyanate of silver, $C_2N_3H_2AgO$; amido-dicyanate of copper, $C_2N_3H_2CuO+2H_2O$; and a series of other salts. The structural formula of amido-cyanic acid is—

$$O=C\begin{matrix}<\\>\end{matrix}\begin{matrix}NH\\NH\end{matrix}\begin{matrix}>\\<\end{matrix}C=NH.$$

On Sulpho-Cyanogen Compounds.—Dr. L. Glutz.—This lengthy essay is divided into the following parts:—Behaviour of sulpho-cyanide of ethyl with concentrated hydriodic acid; derivatives of sulpho-cyanogen ethylen; rhodan ethylsulphinchloride.

On some of the Derivatives of Oxybenzoic Acid.—Dr. A. K. Heintz.

On Ethyloxybenzoic Acid.—G. Rosenthal.

On Thionessal, Tolallylsulphide, Lepiden, and Oxylepiden.—Dr. J. Dorn.

Synthesis of an Acid Homologous with Cinnamic Acid.—R. Fittig and P. Bieber.

On Molybdic Acid and Compounds thereof.—F. Ullick.—This paper, like all the foregoing of which the titles only are quoted, is an essay and monograph, and far too long for any useful abstraction.

Polytechnisches Journal von Dingler, first number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Separator for Water and Steam.—C. von Witzleben.

Improved Evaporator for Saccharine Juices.—M. Schreiber.—Although the contents of these two papers, illustrated by diagrams, do not exactly belong to chemistry, the contrivances described are so useful that we translate the titles.

Furnace for the Proper Combustion of Pulverulent and Wet Fuel.—A. Koch.—Illustrated with engravings.

Researches on the Coals of Upper Silesia (Prussia).—Dr. H. Fleck.—This very extensive and exhaustive monograph is a very valuable addition to our knowledge of coals, from a scientific as well as industrial and technical view of this subject.

Alterations Coal undergoes when Exposed to Air.—Dr. E. Richters.—A continuation of the former portion of this author's paper, containing the following sections:—On the causes of the spontaneous combustion of coals; difficultly-combustible coals; readily-combustible coals. This paper is to be continued.

Estimation of the Average Size of Starch-Globules.—Dr. Schönn.

Method of Obtaining the Oxalic Acid contained in Madder. M. Pernod.—When madder is converted into garancine, the oxalate of lime present naturally in madder is decomposed by the sulphuric acid. The oxalic acid thus set free was hitherto lost in the wash-waters; these fluids are now run into suitably-constructed tanks, and saturated with hydrate of lime, which causes the formation of a large quantity of precipitate of oxalate of lime. This salt is collected, and decomposed by sulphuric acid, carefully added, so as just to be sufficent for the combination of that acid with lime. The sulphate of lime is separated by filtration through flannel, and the solution of oxalic acid evaporated in leaden pans, re-crystallised, and fit for the market. The quantity of this acid thus obtained will vary according to the kind and quality of the madder; and it should be observed, also, that the Avignon madder, employed by the author, contains naturally a large quantity of lime—a base which greatly influences the formation of acids in plants in general, and oxalic acid especially.

Second number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Manufacture of Ice for Industrial Purposes.—Dr. R. Schmidt.—A paper chiefly treating on the cost of machinery and ingredients required for the making of ice for breweries and other places where it is required in large quantities.

Action of Sulphuretted Hydrogen upon Manganese Compounds.—A. Wagner.—The contents of this paper relate to a series of experiments made with the view to ascertain whether the hydrated oxide of manganese is preferable to hydrated peroxide of iron for the purpose of the gas-purification process. It appears, from the author's statements, that the iron preparation is in every respect to be preferred for this purpose.

Bleaching of Yarns and Woven Fabrics with the Permanganates of Potassa and Soda.—A. Pubetz.—The contents of this paper are only interesting to bleachers of linen and cotton materials.

Annales des Mines, No. 6, 1869.

This number contains the following original papers and memoirs:—

Mines and Metallurgical Manufactories of the Banat (a portion of Hungary).—M. Castel.

Additional Notes to a Memoir on the Present State of the Metallurgy of Lead.—L. Grüner.

On some Minerals Found in Chili.—M. Domeyko.—*Tungstate of Copper.*—In 100 parts:—Tungstic acid, 56·48; oxide of copper, 30·63; lime, 2·0; oxide of iron, 2·53; silica, 3·87; water driven off at red heat, 4·62. *On the Titaniferous Sand of the Chilian Sea-board, and on the Origin of that Sand.*—The analysis of two varieties of this sand is quoted percentically, care being taken to analyse separately the magnetic and non-magnetic portions. The following quotation will give an idea of the composition of this material as met with at Punta Arenas (on the Straits of Magellan):—Non-magnetic portion—Titanic acid, 19·2; protoxide of Iron, 29·7; peroxide of iron, 49·7; lime, 0·9; magnesia, 1·0. Magnetic portion—Titanic acid, 22·8; protoxide, 15·8; peroxide of iron, 61·5.

Mineral Resources of the Ariège.—M. Mussy.—A lengthy monograph of one of the Frontier Departments of France, bound by Spain and the ancient Republic of Andorra.

Journal für Gasbeleuchtung, March, 1870.

Bicarbonate of Ammonia in Illuminating-Gas.—Dr. Rüdorff.—The author states that, during the very severe cold which prevailed at Berlin in the month of February last, a quantity of crystals were found deposited in the purifiers of one of the gas-works at Berlin. The substance exhibits a distinctly-crystalline, well-defined, rhombo-prismatic structure. On analysis, the author found, as the average of three experiments, this compound to correspond with the formula NH_4HCO_3, containing 21·52 per cent of ammonia. The crystals are interesting, since it has been hitherto found impossible to prepare this bicarbonate artificially.

Regulation for Securing the Use of Gas with Safety, and Advice as regards the Arrangements of the Gas-Fittings in Dwelling-Houses, Offices, and Public Buildings for Carlsruhe (the Capital City of Baden).—This paper contains some very useful suggestions for the safe employment of gas in general.

NOTES AND QUERIES.

Detection of Strychnia in Organic Matter.—Can any of your readers inform me where I can find a description of Stas's process for the detection of strychnia in organic matter.—ALPHA.

Chlorate of Soda.—"W. H." is referred to Brande's "Manual of Chemistry, vol. i., pp. 563, 609. This work may be inspected at the Library of the Commissioners of Patents.

Wood-paper.—I observe in an advertisement in the CHEMICAL NEWS that Dr. Moffat mentions wood-paper in a list of his investigations. Being anxious for information on the subject of wood-paper, I should feel greatly obliged if the learned Doctor would kindly let me know where his investigations are published. Has any other celebrated chemist devoted attention to the subject?—A. B. C.

Sulphate of Ammonia.—(Reply to "A Working Man.")—When chloride of ammonium is used for the purpose you allude to, 5 parts of that salt, previously powdered, are mixed with 4 parts of slaked lime, and the mixture is moistened so as to form lumps when squeezed in the hands. With sulphate of ammonia you should take equal parts by weight of both lime and the sulphate (a slight excess of the former is preferable), and water as just stated. Sulphate of ammonia only yields 23 per cent of ammonia gas, whereas sal ammoniac yields 32 per cent.

Latent and Sensible Heat.—It is a well-known fact that copper and spelter when brought together, as they are in making brass and yellow metal, generate a large amount of heat in excess of that which they had separately or collectively possessed before. Now, I would feel it a great kindness if you would inform me what this excess of heat amounts to, and how it is accounted for. Suppose, for example, 60 lbs. of copper at its point of liquefaction, or 1996° F., and 40 lbs. of spelter at say 720°, or its point of liquefaction, were put together, what would be the degree of heat or the temperature of the compound?—COMPOUND.

Continuous Current of Air.—In your last number I am reported to have told the Chemical Section of the Glasgow Philosophical Society in my paper on "A Method for Obtaining a Continuous Current of Air, &c.," that, from calculations made, I had no doubt that, with a Herapath lamp, I could get a blast quite as strong as that obtained by using the Griffin lamp." As nearly as I can remember, what I *did say* was that "I was not possessed of a Griffin lamp. But I did not think the blast of air obtained by this apparatus would be sufficiently strong to consume the gas delivered by one; because, with a Herapath lamp, the blast of air obtained was just sufficient to maintain a blue flame when the gas stopcock was full open, and the pressure in the main not greater than 27 mm., or so." By giving this correction a place in your next issue you will greatly oblige.—T. L. PATTERSON, Greenock, April 18th, 1870.

MEETINGS FOR THE WEEK.

MONDAY, 25th.—Medical, 8.
—— Geographical, 8.30.
—— Philosophical Club, 6. Anniversary.

TUESDAY, 26th.—Institution of Civil Engineers, 8.
—— Ethnological, 8.
—— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."

WEDNESDAY, 27th.—Geological, 8.
—— Society of Arts, 8.
—— London Institution, 12. Anniversary.

THURSDAY, 28th.—London Institution, 7.30.
—— Zoological, 8.30.
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Royal Institution, 3. Prof. Tyndall, "On Electricity."

FRIDAY, 29th.—Zoological, 1. Anniversary.
—— Royal Institution, 8. Prof. Blackie, "The Interpretation of Popular Myths."

SATURDAY, 30th.—Quekett Microscopical Club. Excursion to Wimbledon. To meet at Waterloo Station at 2 p.m.
—— Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

TO CORRESPONDENTS.

James Bebbington.—Metallic cobalt is not found native, neither is it met with in commerce except as a scientific curiosity.

THE CHEMICAL NEWS.

VOL. XXI. No. 544.

NOTE ON THE DOUBLE ARSENIATE OF MAGNESIA AND AMMONIA.

By FREDERICK FIELD, F.R.S.

MANY years ago I published in the *Quarterly Journal of the Chemical Society*, vol. xi., p. 6, a paper "On the Composition of the Double Arseniate of Ammonia and Magnesia," after a long investigation of the subject. Mr. E. W. Parnell in the CHEMICAL NEWS (vol. xxi., p. 133), has also written an elaborate memoir on the same substance, and he arrives at the conclusion that at about a temperature of 90° C. ammonia escapes, but more than one equivalent of water is retained, while at a temperature of from 100° to 110° C. this excess of water, and probably more ammonia are driven off, and, therefore, considers that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for counterpoised filter.

Without impugning for one moment the accuracy of Mr. Parnell's analyses, my own experiments seemed so fully to corroborate the excellence of Levot's method for the estimation of arsenic by the formation of the double arseniate, recognised as most satisfactory both by H. Rose and Fresenius, and recommended by those chemists, that I was led to study Mr. Parnell's experiments attentively to see if our methods of working were identical. In referring to the *Quarterly Journal of the Chemical Society*, vol. xi., p. 13, it will be found that it is very necessary to be extremely cautious in the desiccation of the substance in question. Specimens dried upon a filter placed above a sand bath with a thermometer suspended at the same distance from the heated surface (the mercury never rising above 300° F.) were found to have lost the whole of their water in from four to five hours, and from more recent experiments it has been proved that no water can exist even at 230° F. Again, it is stated on the same page, "like the corresponding lime salt, it loses water at a slight increase of temperature (the lime salt loses its equivalent of water at a little above 212° F.)."

Now, upon a careful perusal of Mr. Parnell's paper it appears that a *constant* temperature of 100° C., except in one instance, was not employed, the thermometer ranging from 90° to 110° C. He is, therefore, quite correct in saying that at 90° more than one equivalent of water is retained (*vide Quarterly Journal of the Chemical Society*, vol. xi., p. 13), and also that from 100° to 110° C. the excess of water is driven off.*

Mr. Parnell obtains, in one experiment, where the arsenic has been thoroughly oxidised, by the passage of chlorine through the arsenic acid solution, 0·1690 of arsenious acid from 0·3244 of the double arseniate, a result, he observes, far two low, and which leads him to believe that the formula $(AsO_4,MgNH_4O)2H_2O$ does not represent the composition of the compound after being dried at 100°—110° C. Certainly it does not, for the composition of the double arseniate above 100° C. contains no water, and the calculated quantity of arsenious acid obtained by drying the arsenical compound above 100° C. should be 0·173, not very much above Mr. Parnell's figures. Again, when 1·0152 grms. of air-dried compound were heated in the air bath, at a temperature of 100°—110°, the mean loss by weight in three experiments gave Mr. Parnell 37·86 per cent. In my experiments the loss was 37·41, no very great discrepancy, when reduced to percentages.

With regard to the evolution of ammonia at temperatures under 100° C., I confess it is a matter of grave interest, and has escaped the observation of all former analysts. Rose himself has given the formula of the compound dried at 100° $(NH_4O,2MgOAsO_5)HO$ (old notation), and this has been corroborated by many chemists. I have always noticed the smell of ammonia, and its action upon litmus, when drying the substance, but concluded that it arose entirely from the liquid in which the precipitate was washed upon the filter, and which was always made strongly alkaline, as the double arseniate is far more insoluble in ammonia than in either water or chloride of ammonium.

Mr. Parnell's experiments, therefore, in some respects coincide with my own, inasmuch as he proves that under 100° C. more than one equivalent of water exists, and that above that temperature, according to his own figures (with a slight margin for necessary error), no water exists.

* In Mr. Parnell's paper, "the excess of water and probably more ammonia."

ON CONSECUTIVE POLES IN A MAGNET.

By CHARLES TOMLINSON, F.R.S.

IN the CHEMICAL NEWS (vol. xxi., p. 164) is an account, by Mr. Porter, of some "curious results in the shape of magnetic phenomena." These results refer to the production of what are called, by English writers on magnetism, *consecutive poles*; by the French, *points conséquens*; and, by the Germans, *Folgepunkte*. Although the phenomena which accompany their production are interesting and instructive, they are scarcely noticed in the modern treatises that are in general circulation. Snow Harris, in his "Rudimentary Magnetism," does not describe them, probably for the reason given by Becquerel ("Traité de l'Electricité," vol. i., p. 73)—that a needle containing consecutive points is worthless in observations on terrestrial magnetism. Some of the old treatises give a sufficient account of them; thus, in Cavallo's "Treatise on Magnetism" (second edition, 1795), the following passage occurs at p. 186:—"The magnetic centre, or the limit between the polarities, is not always in the middle of the bar; it is generally nearer that end which is presented to the magnet. This difference is greater as the magnet is weaker and the length of the bar increases; but, when the bar exceeds a certain length (which depends on the strength of the magnet), then the bar acquires several successive poles—viz., when the north pole of the magnet is contiguous to one of its extremities, that extremity becomes a south pole; a few inches farther on you will have a north polarity; then another south polarity, and so on. In this case, the first magnetic centre comes very near that end of the bar which stands next to the magnet, and other magnetic centres are formed between every pair of successive poles: those successive poles become weaker and weaker in power, according as they recede from that end of the bar which is contiguous to the magnet; so that, in a pretty extended bar, they quite vanish long before they come to the farther end of it. Hence, if one pole of a magnet be applied to the end of a long bar, the other end of the bar will not thereby acquire any magnetism."

An effect of this kind may be well shown by magnetising one-half only of a steel knitting-needle about nine inches long.

Experiment 1.—Place a steel knitting-needle on the table, and press it down firmly, by means of a finger, in the middle of its length; then draw the south pole of a strong magnet along the wire, from the finger to the end, about six or eight times, bringing the pole, after each touch, with a wide sweep of the arm, back to the finger. If now the wire be tested, by holding it vertically near a horizontal magnetic-needle, the end of the touched

half will be found to be N.; while the S. pole will be somewhere within the wire, at about 5 inches from the N. pole, and the rest of the wire inactive. On dipping the N. end into iron-filings, a considerable bunch will be taken up. On dipping the other end into the filings, it will attract none of them, until the filings reach the wire at and about S. (Fig. 1), where a large bunch will be taken up.

FIG. 1.

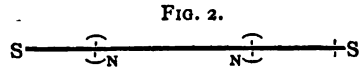
This experiment may be varied by rubbing the N. or S. pole of a strong magnet over about an inch or two of the central portion of a knitting-needle 9 inches long. All three poles will be within the wire, an inch or more at each end being magnetically inactive.

The following experiment will show the action of consecutive poles:—

Experiment 2.—A bar-magnet, 6 inches long and ¼ inch wide, was touched six times on its marked or northern half with the north end of a strong magnetic battery. On passing the bar horizontally before a small dipping-needle, the marked end of the bar strongly attracted the marked end of the needle. At the distance of 1½ inches from the marked end of the bar, the needle suddenly swung round, and presented its S. pole to the bar, and continued to do so until a part of the bar, 1½ inches from the other end, arrived opposite the needle, when this again swung round, and presented its N. pole to the bar for the remainder of its length.

Experiment 3.—The bar being placed on the table, and covered with a sheet of white paper, iron-filings were gently sifted upon it. The resulting figure was very good, showing the poles and neutral lines distinctly. Fig. 2 represents roughly the conditions of the case—

FIG. 2.



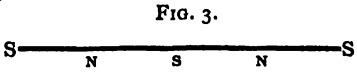
A similar case being produced in a knitting-needle—

Experiment 4.—The needle was broken in the middle, when each fractured end remained a N. pole, the other two ends S. poles, and the neutral point was in the centre of each fragment.

Although, theoretically, the pole is a point situated some way within each end of the bar, in which point all the forces of one kind or other are supposed to be collected (just as the centre of gravity is a point within a body in which all the weight is supposed to be collected), yet, in practice, each half of the bar is often referred to as a pole; and, in the case before us, a considerable portion of the centre of the long wire may be taken as a north pole, bounded on either side by a neutral line, and by a considerable portion of each end which forms a south pole. The extent of north pole in the central portion of the wire is such that it may (as in Experiment 4) be cut through without disturbing the arrangement, each half being now a complete magnet, with the poles and neutral line arranged exactly as they were before the separation; and, further, when the severed ends are brought together, and iron-filings dusted over the whole length, the same figure is produced as before the separation.

Experiment 5.—A knitting-needle was placed on white paper, and the first quarter of its length rubbed with the north pole of a bar-magnet, the second quarter with the south pole, the third with the N., and the fourth with the S. The result of this operation was a needle with five poles—

FIG. 3.

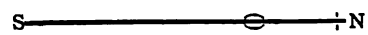


Consecutive poles are due to several causes—such as an over-exertion of the coercitive force, as when we attempt to saturate a bar of steel of too great a length. According to Coulomb, consecutive poles are always formed in needles of tempered steel, where the length exceeds thirty times the diameter. Or, if the steel be of too hard a temper, or of unequal temper, these points are likely to occur from the unequal distribution of the coercitive force. In some cases, they may be made to disappear by a careful re-magnetisation.

According to Coulomb, the neutral line is always brought some millimetres nearer the part of the bar last touched. This may be roughly but strikingly shown by restoring the bar-magnet (Fig. 2) to its natural condition as to polarity.

Experiment 6.—Pass the S. pole of a powerful magnet three or four times over the marked end of the bar (Fig. 2). The two consecutive poles will disappear; but the neutral point will be at about 2 inches, instead of 3, from the marked end, as in Fig. 4.

FIG. 4.

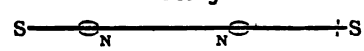


Experiment 7.—Pass the N. pole of the magnet two or three times over the S. end of the bar (Fig. 4), and the neutral point will be at, or very near, the centre.

When a long, magnetised knitting-needle has one of its poles reversed, and two consecutive poles formed, the neutral points are not distributed symmetrically.

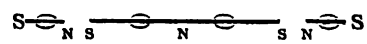
Experiment 8.—Rub the N. pole of the magnet over the N. end of the needle about three times. The needle will have a S. pole at each end, and the N. pole spread over the centre. The neutral lines will be at 1¾ inches from the original S. pole, and 2¼ inches from the reversed N. pole, as in Fig. 5.

FIG. 5.



Experiment 9.—Cut off the two ends of Fig. 5 a little on the S. side of each neutral line. The central portion will be constituted as before—viz., with two extreme S. poles and two inner N. poles, only the neutral points will be brought nearer together. Each of the end fragments is a perfect magnet, with the S. poles undisturbed and the N. poles at the fractured ends, the neutral point being in the middle. Each end of the central piece will lift each fragment by the broken end, and the three pieces being put together in proper order appear thus:—

FIG. 6.



Experiment 10.—Rub N. pole of battery over the N. end of one of the short pieces (2¼ inches long) marked S. N. The effect is simply to reverse the poles, without producing consecutive ones.

If a similar experiment be performed on a regularly magnetised wire not under about 4 inches long, the effect will not, in general, be simply to reverse the poles, as in Experiment 10, but to produce a pole of the same name at each end, while the pole of opposite name occupies the middle portion of the wire, as in Figs. 2 and 5, and the central portion of Fig. 6. Only it must be observed that, in magnetised pieces of steel wire of about 4 inches in length, the end rubbed with the pole of a strong magnet may so far disturb the arrangement of the neutral lines that one may come very near one end, so as to make it somewhat difficult to detect the two poles which such line separates, at least by the dipping-needle or horizontal-magnet test. The figure formed by gently dusting iron-filings over it is an elegant and good test.

Experiment 11.—A magnetised wire, 4¼ inches long, had its northern half rubbed with the N. pole of a strong magnet. Fig. 7 represents the magnetic wire before this treatment, and Fig. 8 the result of the treatment. It will be seen from Fig. 8 that the neutral point on the side

rubbed is 1¼ inches from the rubbed end, while the other neutral point is only ⅛ inch from the other end.

FIG. 7.

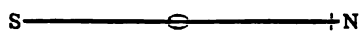
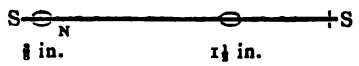


FIG. 8.



I trust the majority of the readers of the CHEMICAL NEWS will excuse the rudimentary nature of the foregoing details into which I have been tempted by what I think are the insufficient descriptions of Mr. Porter. The student may find amusement and instruction in repeating and devising such experiments as have been described. The apparatus required does not necessarily consist of more than a sixpenny horseshoe-magnet, a small compass-needle, a few thin steel knitting-needles, some iron-filings contained in a gauze bag or in a small sieve, and a sheet or two of writing-paper. In order to bring out the effects strongly, I used a magnetic battery, capable of lifting about 20 lbs. weight, for magnetising the wires, and a small, delicately-poised dipping-needle for testing them; but nothing can be more graphic than the iron-filings test, and the filings may be gently dusted on the wire itself or on the white paper placed upon it, assisting the figure, if necessary, by a few taps under the table.

Highgate, N., April 18th, 1870.

ON

NITRIC ACID AND CHLORATE OF POTASSIUM

AS AN

OXIDISING MIXTURE APPLICABLE TO SULPHUR, SULPHIDES, CHROMIUM, ARSENIC, ORGANIC MATTERS, &c.

By FRANK H. STORER,
Professor of General and Industrial Chemistry in the Massachusetts Institute of Technology.

SOME years since, while studying the action of various oxidising agents upon oxide of chromium, I was struck by the superior oxidising power of a mixture of ordinary nitric acid and chlorate of potassium over that of the mixtures of chlorate of potassium and chlorhydric or sulphuric acid commonly used in analysis. Inasmuch as the fact of the great oxidising power of a mixture of nitric acid and the chlorate had already been noticed and explained by several observers,* I at that time contented myself with a simple statement of my own observations of the action of the mixture upon chromic oxide,† without referring in any way to the general value of the mixture as an oxidising agent. Since that time, however, I have had frequent occasion to employ the mixture for effecting the oxidation of many substances besides oxide of chromium, such as present themselves in the ordinary experience of an analytical laboratory, and have satisfied myself that the merit of the process has not hitherto been duly appreciated.

Experience has convinced me, not only that a mixture of nitric acid and chlorate of potassium oxidises more rapidly than the common mixture of chlorhydric acid and chlorate of potassium, but that it is really to be preferred, in the great majority of cases, to any of the agents ordinarily employed to effect oxidation in the wet way. Instead of occupying, as now, a secondary or alternative place in the treatises on analysis, it ought to take precedence of the other processes of oxidation. It may be used with advantage in many instances where dry methods of oxidation are now recommended. With the exception perhaps, of the sulphides or other compounds of antimony and tin, there are probably but few cases where its use will be found inadmissible.

The following notes include the results of several researches made by students of the Massachusetts Institute of Technology with the view of testing the capabilities of the process:—

Estimation of Sulphur in Organic Compounds. By A. H. PEARSON.

It is easy to determine sulphur in non-volatile organic compounds, by oxidising the substance with chlorate of potassium and nitric acid, precipitating the sulphuric acid as sulphate of barium, and washing the latter with a solution of acetate of ammonium, to remove any nitrate of barium which may have adhered to it.

To oxidise the sulphur compound, place a weighed quantity of it in a porcelain dish, pour upon it three or four table-spoonfuls of strong nitric acid (39° B.), free from sulphuric acid, and add to the acid half a tea-spoonful of chlorate of potassium. Cover the mixture with an inverted glass funnel, the stem of which has been bent to a right angle. Place the dish on a wire-gauze support, and heat its contents. From time to time, lift the funnel slightly, and throw a small fragment of chlorate of potassium into the hot acid.

The funnel must be of such size that its rim may fall within the rim of the dish, and rest securely upon the sides of the dish, above the liquid. It serves to retain the particles of liquid which are thrown up from the dish by the gas evolved during the decomposition of the chlorate.

The oxidation will be completed more or less rapidly, according to the character of the substance operated upon. Only five or ten minutes are required to completely oxidise a third of a gramme of sulphocyanide of potassium, while from half to three-quarters of an hour are needed to destroy the same weight of ordinary free sulphur. It may be observed, in passing, that sulphur which has just been distilled dissolves twice as rapidly in a mixture of nitric acid and chlorate of potassium as sulphur which has long been exposed to the air.

Several samples of sulphocyanide of potassium, oxidised in this way, gave the following results:—

A. 0·2015 grm. of the sulphocyanide gave 0·5114 grm. of sulphate of barium. (I.)
A. 0·265 grm. of the sulphocyanide gave 0·6547 grm. of sulphate of barium. (II.)
B. 0·149 grm. of the sulphocyanide gave 0·3796 grm. of sulphate of barium. (I.)
B. 0·012 grm. of the sulphocyanide gave 0·03 grm. of sulphate of barium. (II.)
C. 0·101 grm. of the sulphocyanide gave 0·2387 grm. of sulphate of barium.
D. 0·028 grm. of the sulphocyanide gave 0·067 grm. of sulphate of barium. (I.)
D. 0·084 grm. of sulphocyanide gave 0·204 grm. of sulphate of barium. (II.)

The sulphocyanide used for the experiments mentioned in the paragraphs marked "A" was prepared by fusing together ferrocyanide of potassium, carbonate of potassium, and sulphur, in the usual way, treating the fused mass with hot alcohol, and allowing the alcoholic solution to crystallise. That used for the experiments in paragraphs B was prepared in precisely the same way as the foregoing, but at another time. The salt prepared in this way is evidently contaminated with free sulphur, or some sulphur compound other than the sulphocyanide which has been taken up by the alcohol.

The experiment recorded in paragraph C was made with crystals which separated from the alcoholic mother-liquid of B.

The experiments marked D were made with purified crystals, obtained as follows:—A quantity of the crude

* Compare Gmelin's "Handbook of Chemistry," vol. iii., p. 61.
† *Proceedings of the American Academy*, 1859, vol. iv., p. 342; *Journal für Praktische Chemie*, vol. lxxx., p. 44.

alcoholic crystals, similar to those used in experiments B, was dissolved in water; the solution was filtered to separate sulphur, and placed under a bell-glass, over strong sulphuric acid, to crystallise. The crystals thus obtained were re-dissolved in alcohol, the solution filtered to separate carbonate of potassium, then concentrated by evaporation, and made to crystallise. The crystals were quickly pressed between folds of filter-paper, and portions of them were weighed out for the analyses.

The crystals obtained directly from the aqueous solution of the sulphocyanide were contaminated to a considerable extent with carbonate of potassium; but, after they had been re-crystallised from alcohol, only traces of the carbonate were found upon them.

Stated in terms of per cents, the results may be tabulated as follows:—

		Found. I.	Found. II.	Theory.
A.	Impure crystals	34·85	33·91	
B.	Impure crystals	34·98	34·33	
C.	.. .. ..	32·45	—	32·90
D.	.. .. ..	32·85	32·86	32·90

I have applied the foregoing method, not only to sulphocyanide of potassium and to free sulphur, as above described, but also for estimating sulphur in vulcanised caoutchouc, and in several samples of anthracite and bituminous coal. It is easy to completely oxidise either of these substances by means of the mixed chlorate of potassium and nitric acid. Anthracite dissolves even more readily than bituminous coal, since, unlike the latter, it does not fuse to a single mass in the hot acid.

It is not improbable that, by a slight variation of the foregoing process, it may be found practicable to determine the carbon of an organic compound at the same time as the sulphur. Thus, the oxidation might, perhaps, be effected in a flask, provided with a wide funnel-tube for the addition of the chlorate, and a delivery-tube through which the carbonic acid formed could be led into baryta-water or some other substance fit to absorb that gas. Upon this point, however, I have as yet made no experiments.

May, 1869.

Assay of Sulphur in Iron Pyrites. By A. H. PEARSON.

The proportion of sulphur in iron pyrites ("sulphur-ore") may be readily and accurately estimated as follows:—Weigh out 1 grm. or less of the powdered ore, place the powder in a porcelain dish, together with a small quantity of chlorate of potassium, pour upon it some 50 c.c. of pure nitric acid of 39° B., and cover the mixture with an inverted glass funnel with bent stem. Set the dish upon a water-bath, and heat the water to boiling. From time to time throw crystals of chlorate of potassium into the hot acid. By adding rather large crystals of the chlorate at frequent intervals, it is easy to oxidise the whole of the sulphide in half an hour; but, since the solution obtained in that case is highly charged with saline matter, it will usually be found more advantageous to use less of the chlorate of potassium, and to allow a somewhat longer time for the process of oxidation.

When all the sulphur has been oxidised, rinse the funnel with water, and remove it from the dish. Evaporate the liquid to a small bulk, then add to it a little concentrated chlorhydric acid, and again evaporate to absolute dryness, in order to render silicic acid insoluble. Moisten the residue with concentrated chlorhydric acid, mix it with water, and filter to separate silicic acid and gangue.

To the filtrate from the silicic acid add a quantity of solid tartaric acid, about as large as that of the pyrites originally taken; heat the liquid almost to boiling, and add to it an excess of chloride of barium, to precipitate the sulphuric acid. After the sulphate of barium has been allowed to subside, wash it thoroughly by decantation, first with hot water, and afterward with a dilute solution of acetate of ammonium; the latter may be prepared at the moment of use, by mixing ammonia-water and acetic acid. The purpose of the acetate of ammonium is to dissolve any nitrate of barium which may adhere to the sulphate; that of the tartaric acid is to prevent the precipitation of iron compounds together with the sulphate of barium. In an experiment where 0·7 grm. of pyrites was oxidised with chlorate of potassium and nitric acid, and the filtrate from silica was acidulated with chlorhydric acid without the addition of tartaric acid, there was thrown down, on the addition of chloride of barium, a bright yellow precipitate, which became darker-coloured when the solution was boiled. It was not only found to be impossible to wash out the iron with which this precipitate was contaminated, but the consistency of the precipitate was such that it was a difficult matter even to wash away the saline liquor in which the precipitate was formed.

In another experiment, the attempt was made to remove the iron from the filtrate from silica, before adding the barium-salt to throw down the sulphuric acid; but in that case a considerable portion of the sulphuric acid was dragged down as sulphate of potassium by the iron precipitate, and so lost. The precipitation of the iron was effected, in this experiment, by adding an excess of ammonia-water to the acidulated filtrate from silica, and washing the precipitate for a long time by decantation with boiling water. To prove that the iron precipitate really retained sulphuric acid, a quantity of the precipitate was dried, ignited, and powdered, and the powder boiled with water. The clear liquid thus obtained was acidulated with chlorhydric acid, and tested with chloride of barium. An abundant precipitate of sulphate of barium was at once thrown down.

After the sulphur of the pyrites has been determined by precipitating it from a tartaric-acid solution, as above described, the iron might perhaps be estimated in the filtrate, by one of the new methods of titration with hyposulphite of sodium. I have made no experiments with the hyposulphite, but have failed completely in several attempts to determine the iron as a sulphide by precipitating with sulphide of sodium, as directed by Fresenius. I found it impossible to wash the sticky, slimy mass of sulphide of iron. It is not easy, on the other hand, to destroy the tartaric acid by igniting the dried filtrate from sulphate of barium in a muffle; for, on evaporating this solution, the saline matters with which it is charged continually creep over the edges of the dish.

November, 1868.

Assay of Copper Pyrites. By F. P. PEARSON.

The following method of treating copper pyrites has been found more advantageous than the ordinary process of oxidising the mineral with aqua regia, and subsequently evaporating the solution repeatedly with chlorhydric acid, or with sulphuric acid, to expel the last traces of nitric acid:—

Place a weighed quantity of the powdered mineral, together with some chlorate of potassium, in a porcelain dish. (Five grms. of a variety of pyrites containing about 18 per cent of copper was found to be enough for one analysis; and a quantity of chlorate of potassium equal to a small tea-spoonful was added to the ore). Invert a small glass funnel with bent stem in the dish above the pyrites, and pour upon the latter rather more ordinary strong nitric acid than would be sufficient to completely cover the powder. Place the dish upon a water-bath, and, from time to time, throw into it small quantities of chlorate of potassium. The doses of the chlorate must be repeated at frequent intervals, until free sulphur can no longer be seen in the dish. If need be, add nitric acid, also, from time to time, to replace that lost by evaporation.

As a general rule, it is safer and more convenient to heat the mixture on a water-bath than upon sand, though I find that the oxidation of sulphur can be effected

more easily and quickly when the mixture of nitric acid and chlorate is heated to actual boiling than at the temperature obtainable by means of a water-bath. When the last particles of sulphur have been destroyed, remove the inverted funnel from the dish, rinse it with water, and collect the rinsings in a beaker by themselves. Allow the liquid in the evaporating-dish to become cold, pour upon it a quantity of ordinary strong chlorhydric acid rather larger than the quantity of nitric acid taken at first, evaporate the mixed solution to dryness, and heat the dry residue to render silica insoluble, in case any silica be present.

Pour water upon the cold residue, and, without filtering the liquor, wash the contents of the dish into the beaker which contains the rinsings of the funnel. Heat the liquid in the beaker nearly to boiling, add to it about 25 c.c. of a strong aqueous solution of ferrous sulphate slightly acidulated with sulphuric acid, and keep the mixture at a temperature near boiling during four or five minutes, in order to destroy the small quantity of nitric acid which has escaped decomposition in spite of the evaporation with chlorhydric acid.

The ferrous salt seldom or never acts instantaneously, but the reducing-action proceeds rapidly and perfectly satisfactorily when once begun. If need be, add more of the ferrous solution, little by little, until the entire contents of the beaker become dark-coloured or almost black and no more gas is disengaged.

In order to be sure that all the nitric acid has been reduced, it is well enough, after the mixture of liquid and solution of ferrous sulphate has been duly heated, to place a drop of the mixture upon porcelain, and test it with ferricyanide of potassium. In general, however, the colouration of the liquor in the beaker, due to the formation of nitrous or hyponitric acid, will be a sufficient indication that the copperas has done its work. The nitrous fumes quickly disappear from the liquid at a subsequent stage of operations when metallic iron is immersed in the solution.

When enough of the ferrous sulphate has been added, filter the mixed solution into a wide beaker, precipitate the copper, in the metallic state, upon a sheet of iron in the usual way, and ignite the copper, in a porcelain crucible, in a current of hydrogen, before weighing it.

By means of the ferrous salt, the last traces of nitric acid may be got rid of far more quickly, conveniently, and certainly, than by the old system of evaporating the pyrites-solution with several successive portions of chlorhydric acid. By treating the pyrites with chlorate of potassium and nitric acid, it is easy to oxidise and dissolve every particle of the sulphur in the mineral, so that no portion of the latter can escape decomposition by becoming enveloped in free sulphur. When aqua regia is used, on the other hand, or a mixture of chlorate of potassium and chlorhydric acid, a certain proportion of sulphur almost invariably remains undissolved, and might easily enclose portions of the mineral, so as to protect them from the solvent action of the acids.

The method of oxidation above described can manifestly be employed with advantage for dissolving many other sulphuretted ores besides copper pyrites.

January, 1869.

Estimation of Sulphur in Sulphide of Mercury. By E. W. BOWDITCH.

In order to contrast the action of the mixed nitric acid and chlorate of potassium with that of the mixture of chlorhydric acid and chlorate of potassium ordinarily employed by chemists as an oxidising agent, a series of comparative experiments were made upon commercial vermillion.

Eight portions of the vermillion were operated upon, in succession, as follows:—In each instance, about 0·5 or 0·6 grm. of the vermillion was placed in a small glass flask, set in an inclined position upon a wire-gauze support above a lamp. A quantity of nitric acid of 39° B., or of concentrated chlorhydric acid, as the case might be, was poured into the flask; a small quantity of chlorate of potassium was added, and the mixture heated. From time to time, small bits of chlorate of potassium were thrown into the flask, the contents of which were maintained near the boiling-point until all the sulphur, or as much of it as possible, had dissolved.

In every instance where nitric acid was employed, the vermillion was, in a short time, oxidised and dissolved so completely that no trace of free sulphur could be seen in the liquor. But, when chlorhydric acid was used to decompose the chlorate, there remained, invariably, floating upon the liquid, one or more yellow globules of undissolved sulphur, varying in size from that of a pin's head to a flax-seed. These floating globules could not be destroyed by any practicable amounts of the chlorate and acid; in fact, it may be said to be impossible to destroy such globules with these reagents.

Whenever chlorhydric acid was used, therefore, to decompose the vermillion, the solution obtained had to be filtered, to separate the free sulphur, before the sulphuric acid in the solution could be precipitated as sulphate of barium. The presence of free sulphur is objectionable, not only because time is lost in collecting, washing, drying, and weighing it, but also on account of its liability to enclose and conceal particles of the substance to be analysed, which would be dissolved by the acid if the latter were able to act upon them. The determination of sulphur may thus be rendered incorrect by weighing the undissolved substances with the sulphur.

When nitric acid was used with the chlorate, it happened sometimes, when the proportion of nitric acid was small, that a considerable quantity of saline matter crystallised in the flask; it was found, however, that enough water to re-dissolve this precipitate might be added to the mixture, without impairing to any material extent the oxidising power of the chlorate subsequently added. The acid liquor resulting from the action of nitric acid and chlorate of potassium upon the vermillion was evaporated to dryness on a water-bath, and the residue treated with strong chlorhydric acid, in order to destroy most of the nitric acid before proceeding to precipitate the sulphuric acid with chloride of barium. Before adding the chlorhydric acid to the residue, the latter must be allowed to become perfectly cold, lest the mixture froth violently, and portions of it be thrown out of the flask. After the acid has once been added, however, the mixture may be heated gently without risk of loss.

No matter whether chlorhydric or nitric acid is employed with the chlorate, the solution must at last be largely diluted with water before adding the chloride of barium.

In my experiments, nothing but hot water was employed to wash the sulphate of barium. Naturally enough, it was more difficult to wash, in this way, the precipitates obtained from solutions contaminated with nitric acid than those from the solutions which contained only chlorhydric acid; but, in spite of this disadvantage, and of the long time required to wash out the last traces of nitrate of barium, I have always found that a sulphur determination made by the nitric-acid process requires much less time for its completion than one made by the old way with chlorhydric acid.

In a final trial, made expressly for the purpose of testing this point, the precise times consumed in making each experiment were carefully noted. Two portions of the vermillion were weighed out into flasks, and treated, one with chlorhydric acid and chlorate of potassium, and the other with nitric acid and the chlorate. The portion treated with chlorhydric acid weighed 0·5695 grm., and the other 0·519 grm. The flask containing the sample treated with chlorhydric acid was taken from the fire a few minutes before the last traces of sulphur in the nitric-acid flask had been destroyed, and the separation of the undissolved sulphur was proceeded with as rapidly as possible; but, in the end, it was found that eleven hours

and three-quarters were required to complete the determination of sulphur in the portion of vermillion treated with chlorhydric acid, while the estimation of sulphur in the other portion, treated with nitric acid, was finished in nine and a half hours. 14·32 per cent of sulphur was found in the portion treated with nitric acid, and 14·25 per cent in the portion treated with chlorhydric acid, instead the 13·79 per cent required by theory.

February, 1868.

Estimation of Chromium as Chromate of Barium. By A. H. PEARSON.

As Professor Storer has shown,* chromic oxide is quickly changed to chromic acid when boiled with a mixture of concentrated nitric acid and chlorate of potassium. All the chromium in ½ grm. of hydrate of chromium, or of any of the ordinary chrome salts, can in this way be converted into chromic acid in a few moments; and even compounds as refractory as chrome-iron ore, or oxide of chromium which has been strongly ignited, can be oxidised in less time than would be required to complete their oxidation by the process of fusion ordinarily employed.

As will appear from the experiments which follow, the chromic acid thus formed in the wet way can be readily and accurately estimated in the form of chromate of barium, if care be taken to wash the precipitated chromate with acetate of ammonium, or some other saline solution in which chromate of barium is insoluble.

1. A quantity of anhydrous chromic oxide was prepared, by heating bichromate of potassium with an excess of strong chlorhydric acid until chlorine ceased to be evolved, saturating the acid liquor with ammonia-water, washing and drying the precipitated hydrate, and finally igniting it intensely in a platinum crucible over a blast-lamp.

0·102 grm. of this anhydrous oxide was placed in an evaporating-dish, together with a quantity of nitric acid and some chlorate of potassium, and covered with an inverted funnel with a bent stem. The acid was heated, and fragments of chlorate of potassium were added to it from time to time, until the chromic oxide had completely disappeared. This result was attained in the course of half an hour.

The acid solution was diluted with water, then neutralised with ammonia, and the ammoniacal solution in its turn treated with enough acetic acid to make it slightly acid. After the acidulated solution has become cold, a solution of chloride of barium was added to it in slight excess, and the mixture was left at rest for ten or twelve hours. The precipitated chromate of barium was washed by decantation with a cold solution of acetate of ammonium, then collected on a filter, rinsed with water, dried, heated in a crucible to expel the last traces of water and of the ammonium-salt, and weighed.

The amount of chromate of barium obtained in this experiment was equal to 0·336 grm., which is equivalent to 68·31 per cent of chromium, instead of 68·62 per cent as required by theory.

The precipitate of chromate of barium must be allowed to stand for some time before filtering, lest it pass through the pores of the filter, and render the filtrate cloudy.

The acetate of ammonium employed for washing serves to dissolve any nitrate of barium or chloride of barium which may have been precipitated with the chromate; it has the further advantage of dissolving less of the chromate of barium than pure water would.

2. A quantity of hydrate of chromium, precipitated from a solution of reduced bichromate of potassium, as in the previous experiment, was dried at 115°, and the proportion of water retained by the dried hydrate was determined once for all by ignition.

0·11 grm. of this dried hydrate, equal to 0·0688 of the anhydrous oxide, was then treated with nitric acid and chlorate of potassium, as in experiment 1. It was found that the oxidation was completed as soon as the acid became hot enough to decompose the chlorate. Less than five minutes were sufficient, in this instance, for the complete conversion of the chromium to chromic acid.

The chromate of barium obtained weighed 0·2286 grm., equivalent to 68·65 per cent of chromium in the oxide taken, instead of the theoretical 68·62 per cent.

3. 0·113 grm. of the dried hydrate, containing 0·0707 grm. of the anhydrous oxide of chromium, was mixed with a quantity of nitrate of magnesium (prepared by dissolving carbonate of magnesium in nitric acid), before the treatment with nitric acid and chlorate of potassium. 0·2346 grm. of chromate of barium was obtained; in other words, 68·60 per cent of chromium, instead of the 68·62 per cent required by theory.

4. 0·114 grm. of the dried hydrate of chromium, containing 0·0713 grm. of the anhydrous oxide, was mixed with nitrate of aluminum (prepared by dissolving hydrate of aluminum in nitric acid), before the treatment with chlorate of potassium. 0·2356 grm. of chromate of barium was obtained; that is to say, 68·31 per cent of chromium, instead of 68·62 per cent.

5. A small quantity of chrome-iron ore was ground to very fine powder, and treated, in a dish, with nitric acid and chlorate of potassium, as above described. At the end of half an hour, that portion of the ore which still remained undissolved was washed with water, dried, fused with a mixture of carbonate of sodium and nitrate of potassium, and the fused mass boiled with water; but the solution thus obtained gave no reaction for chromium when tested for that substance.

It appears, from the foregoing experiments, that chromium can be readily estimated in this way in presence of aluminum and magnesium. The process can doubtless be employed also for separating chromium from iron, cobalt, nickel, and zinc. As a matter of course, special care must always be taken to employ reagents which are absolutely free from any contamination of sulphuric acid.

April, 1869.

On the Use of Chromate of Barium in Quantitative Analysis. By R. H. RICHARDS.

A sample of pure bichromate of potassium, examined simultaneously by three of the students in the Institute's laboratory, for the purpose of determining the percentage of chromium by precipitating that element in the form of chromate of barium, gave the following discordant results (the method of analysis was similar to that described below):—

Name of experimenter.	Grms. of $K_2O,2CrO_3$ taken.	Grms. of BaO,CrO_3 found.	Percentage of chromium.	
			Found.	Theory.
N. F. Merrill	0·516	0·8640	34·67	35·56
F. P. Pearson	0·500	0·8788	36·38	,,
C. E. Avery	—	—	36·31	,,
,,	—	—	36·24	,,

At the suggestion of Professor Storer, I have examined other portions of the same sample of bichromate of potassium, with the view of discovering, if possible, the sources of error which vitiated the foregoing analyses.

A quantity of the bichromate was heated until it fused, the cold mass powdered and several portions of it, weighing from one to two grms. each, were taken for analysis. Each of the weighed quantities of bichromate was dissolved in distilled water; the solution was heated nearly to boiling, and a lump of acetate of sodium twice the volume of the bichromate of potassium taken was thrown into the hot liquor. Acetic acid was then added to strongly acid reaction, and afterwards a solution of chloride of barium, with occasional stirring, until no more precipitate was formed on the further addition of chloride of barium and until the supernatant fluid became absolutely colourless. It is easy to hit this point in a hot solution but not so easy when the liquid is cold.

After the precipitate had been allowed to stand for some time, the clear liquid above it was decanted into a

* *Proceedings of the American Academy*, 1859, vol. iv., p. 342.

filter. The precipitate was then washed with cold water, first by decantation in the beaker and afterwards upon the filter. The filtrate proper, that is to say, the clear liquor decanted from the precipitate, was in every instance colourless. It gave a white residue when evaporated on platinum foil and no precipitate when tested with acetate of lead. But all the subsequent liquors obtained by decantation and washing came through the filter distinctly yellow-coloured. They gave yellow residues when evaporated upon foil and bright yellow precipitates when tested with acetate of lead. It was, consequently, no easy matter to determine when to stop washing. The precipitates were, in fact, put aside to dry as soon as there was any reason to suppose that the saline mother-liquor had all been washed out from them.

In the second of the following experiments the chromate of barium was weighed upon a tared filter, as was the case also in the experiments cited above, but in Nos. 1, 3, and 4, the dry precipitate was ignited gently in a porcelain crucible before weighing.

No. of the experiment.	Grms. of $KO_2,2CrO_3$ taken.	Grms. of BaO,CrO_3 found.	Percentage of chromium found.	Theory.
1.	1·0095	1·7301	35·47	35·56
2.	1·0175	1·8444	37·53	
3.	1·5456	2·7541	37·74	
4.	1·5020	2·5696	35·49	

Experiments 3 and 4 were carried out side by side, and every effort made to treat them exactly alike.

From the appearance and behaviour of the wash-water, as above described, it appears that chromate of barium is somewhat soluble in pure water, but is insoluble in tolerably strong saline solutions, even in the presence of acetic acid. This observation agrees in the main with a statement* in Professor Storer's "Dictionary of Solubilities" to the effect that "chromate of baryta is very slightly soluble in water, and even insoluble when other salts are present in solution."

On the other hand, the excess of precipitate found in experiments 2 and 3, would go to show that chloride of barium is liable to be dragged down by chromate of barium in the same way that it is apt to go down with sulphate of barium. It would appear, therefore, that some saline solution, competent to dissolve chloride and nitrate of barium, should be used instead of water for washing chromate of barium. [P.S.—In accordance with this view Mr. A. H. Pearson has recently employed a solution of acetate of ammonium, with the best results, for washing both the chromate and the sulphate of barium.]—*American Journal of Science*, vol. xlviii., No. 143.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

April 21st, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

T. PATCHETT was elected a Fellow.

Professor ROSCOE, F.R.S., delivered a lecture "*On Vanadium.*"

This metal was discovered in 1830, by Sefström, in the celebrated Swedish bar-iron made from the Taberg ore. Sefström ascertained some of the most peculiar characters of this substance, proved it to be a new element, and prepared some of its compounds in the pure state. The reactions by which vanadium can be separated and distinguished from all the other elements are:—(1) The formation of a soluble sodium vanadate when the vanadium compounds are fused with sodium carbonate; (2) the formation of an insoluble ammonium vanadate when sal ammoniac is added to the solution of a soluble vanadate; (3) the production of a splendid blue solution when this ammonium salt, dissolved in hydrochloric acid, is warmed with reducing agents, such as oxalic acid.

Sefström, not having leisure to prosecute the full examination of the properties of the new metal, handed over his preparations to Berzelius; and it is to the investigations of the great Swede that we owe almost all our acquaintaince with the chemistry of vanadium.

Since Berzelius's time, vanadium has been discovered in many minerals, of which a lead ore containing lead vanadate, and called by the mineralogists, vanadinite, is the most important.

In 1865, Professor Roscoe came into possession of a plentiful source of vanadium, in a by-product obtained in the preparation of cobalt from the copper-bearing beds of the lower Keuper Sandstone of the Trias, at Alderley Edge, in Cheshire. Following, in the main, the process of preparation adopted by Sefström, Professor Roscoe obtained, from the above-mentioned source, several pounds of pure ammonium vanadate, from which all the other compounds of vanadium can be prepared.

What, now, were the conclusions to which Berzelius arrived, from his experiments concerning the constitution of the vanadium compounds? He assigned to its three oxides the formulæ VO, VO_2, and VO_3, whilst the chloride was represented by VCl_3. The atomic weight of the metal he found to be V = 68·5.

Some years afterwards, Rammelsberg observed that vanadinite, a double salt of lead-vanadate and lead chloride, is isomorphous with apatite and with mimitesite, the former containing phosphoric, the latter arsenic acid. This crystallographic analogy would lead us to conclude that the oxide of vanadium in the vanadinite has the formula V_2O_5, agreeing with the corresponding oxides of phosphorus and arsenic, P_2O_5 and As_2O_5; but the unyielding chemical facts of Berzelius compel us to view the oxide in question as VO_3. It was, then, evident that here was either an exception to the law of isomorphism, or else Berzelius's views were erroneous.

Professor Roscoe, in order to endeavour to clear up this question, had carefully repeated Berzelius's experiments, and he found them confirmed in every particular; but, having pursued the subject further than Berzelius, he had succeeded in obtaining the key to the enigma presented by the above anomalous crystallographic relations.

The lecturer has proved that the substance supposed by Berzelius to be vanadium, is not the metal, but an oxide, and that the true atomic weight of the metal is 51·3. The vanadic acid, VO_3, of Berzelius, hence, becomes V_2O_5, corresponding to P_2O_5 and As_2O_5; and the above-mentioned isomorphism is fully explained. The sub-oxide of Berzelius is a tri-oxide, V_2O_3; whilst the terchloride (VCl_3) of Berzelius is an oxychloride, $VOCl_3$, corresponding to oxychloride of phosphorus, $POCl_3$.

Professor Roscoe has succeeded in obtaining bromine and iodine compounds of vanadium, and also various metallic vanadates. He went on with his lecture by pointing out that the characters of the vanadates bear out the analogy of the vanadic acid with the highest oxides of phosphorus and arsenic; and stated, in conclusion, that vanadium, hitherto standing in no definite relation to other elements, must now be regarded as a member of the well-known triad class of elementary substances, comprising nitrogen, phosphorus, boron, arsenic, antimony, and bismuth.

The PRESIDENT, in proposing a vote of thanks to the lecturer, called attention to the great service Professor Roscoe had rendered to chemical science by his successful investigation of vanadium.

After the delivery of this lecture, Professor HOFMANN, from Berlin, favoured the Society with a few observations

* Cited from Dumas's Traité de Chemie appliquée aux Arts.

on an organic body he had obtained by treating sulphourea with silver oxide. This substance, CH_2N_2, is distinguished by its great tendency to polymerise.

Dr. Hofmann further communicated that a compound isomeric with chloral had recently been discovered by two Berlin chemists. It differs from ordinary chloral by its much higher boiling point.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 5th, 1870.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*Description of a New Anemometer.*" By Peter Hart.

On the appearance of Mr. Fletcher's admirable paper "On the Speed of Air in Flues," it appeared to me that an anemometer more easily read and less costly than his was desirable. With this view I devised the present one, which may be broadly described as a common U-tube gauge laid in a sloping position, so as to form the hypotenuse of a right-angled triangle, the perpendicular of which is the true reading.

The following description will explain its construction:—

It consists first of a base board furnished with levels and levelling screws; to this is hinged the board carrying the U-tube, which may be called the sloping base; on this sloping base is secured the U-tube furnished with a scale and vernier capable of being read to the 1-100th inch. By means of a screw passing through the sloping base, and resting on the lower base board, the former can be made to assume any angle with the latter, the angle being determined by a quadrant fixed to the lower base board.

By this arrangement a very great degree of accuracy in reading is obtainable. Thus, in the present instrument, the quadrant is set 5 inches distant from the hinge, and when set at 0·5 inches on the quadrant, it gives a rise of 1 in 10; consequently, the ether in the U-tube has to move 10 inches for 1 inch of vertical rise. The rule for getting the result may be stated thus:—

Divide the space between the hinge and the quadrant by the quadrant elevation, now divide the movement of the ether by the quotient, and the product is the true vertical movement *nearly*.

Thus, suppose, as before, the quadrant elevation to be 0·5 inch, the distance from hinge to quadrant 5·0 inches, and the ether's movement 1 inch: then—

$$\frac{5}{0{\cdot}5} = 10 \text{ and } \frac{1{\cdot}0}{10} = 0{\cdot}1 \text{ inch.}$$

Or again, the quadrant elevation being 0·2 inch, the other quantities the same: then—

$$\frac{5}{0{\cdot}2} = 0{\cdot}25 \text{ and } \frac{1{\cdot}0}{1{\cdot}25} = 0{\cdot}04 \text{ inch.}$$

These results, though not absolutely correct, will, in most cases, be sufficiently so; but where rigid accuracy must be had, the following table will supply the means:—

Quadrant Elevation in 10 inches.	Hypotenuse.	Quadrant Elevation in 10 inches.	Hypotenuse.
0·1 inch ..	10·00049	1·1 inch ..	10·06035
0·2 ,, ..	10·00199	1·2 ,, ..	10·07174
0·3 ,, ..	10·00449	1·3 ,, ..	10·08414
0·4 ,, ..	10·00799	1·4 ,, ..	10·09752
0·5 ,, ..	10·01248	1·5 ,, ..	10·11187
0·6 ,, ..	10·01799	1·6 ,, ..	10·12714
0·7 ,, ..	10·02447	1·7 ,, ..	10·14347
0·8 ,, ..	10·03199	1·8 ,, ..	10·16061
0·9 ,, ..	10·04049	1·9 ,, ..	10·17888
1·0 ,, ..	10·04987	2·0 ,, ..	10·19803

First find what aliquot part of 10 the quadrant elevation was; find this in the quadrant column. Opposite this will be found a number which is the hypotenuse. Then, as this number is to 10, so is the number obtained by the first method to the true number.

Thus, to take the first illustration, of 0·5 in 5 inches: this is equal to 1 in 10. The hypotenuse of 1 in 10 (see table) = 10·04987. Now, 0·1 inch was the result obtained. Then, as 10·04987 : 10 :: 0·1 : 0·09955, which is the true vertical rise.

I had no little difficulty in my first efforts to restrain the excessive oscillations of the ether column, owing to the almost constant fluctuations of draught in flues. To obviate this the tube was choked to a narrower bore at the bend. This proving insufficient, I overcame the defect by the very simple means of inserting a piece of sponge at this part.

It is, perhaps, needless to add that it is necessary to employ Mr. Fletcher's tubes for insertion into the flue, and also his tables.

CORRESPONDENCE.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

Sir,—I have been much interested in the discussion on the above subject, which has appeared in your journal, but I think there is some want of precision in some of the statements that have been made.

In the Chemical News, vol. xxi., p. 106, there appeared a translated extract from a paper of Mr. Hofmann's containing the statement:—"By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt." My attention was arrested by this statement, but on enquiry I was informed by an excellent German chemist who had access to the original paper, that Dr. Hofmann merely claimed to manufacture an equal product of sulphuric acid with *one per cent less nitric acid than had formerly been in general use.* This would change the entire aspect of the question, for I know very well that British manufacturers profess to procure an adequate return (say, from 286—294 H_2SO_4, specific gravity 1·846, from 100 of S.) of acid, while they vary in the percentage of nitrate of soda, which they consume in the process from 2·5 up to 8 or 9. The quantity of nitrate used very much depends on the chamber room, regularity of working, supply of steam and air, &c., and on this account I am strongly of opinion that, valuable as Dr. Hofmann's suggestion may be (and I intend to give it a fair trial, extending over many weeks unless deterred by its decided failure), I cannot regard it as more than a small item in a very complex question.

From the few data given by Mr. Spence, we may arrive at an approximation to the results obtained by him; and, if my calculations are correct, I think it will appear that Mr. Spence has not yet attained all that he might wish for. Mr. Spence tells us that he requires about 100 tons of acid, sp. gr. 1·845, per week, and that, in making this quantity of acid, he expended 4 tons 2 cwts. of nitrate of soda. Now, if we assume that the production of acid is adequate (294 from 100 S.), then Mr. Spence was using, before his late change in working, 12·06 to 100 of sulphur. If, on the other hand, we assume that Mr. Spence, in common with many manufacturers, expends only 8 per cent of nitrate in the case of sulphur, or 4·5 per cent to Mason's ore, then his kilns should consume 51 tons of sulphur, producing 145—150 tons of acid, sp. gr. 1·845, or, if he burn pyrites, 91 tons of Mason's ore, giving 125 tons of acid. The above data are founded on the quantities quoted by Mr. Spence, and are as precise as the absence of the absolute weights used and obtaine

will permit; but they demonstrate that it is perfectly possible to obtain an improvement, and that a very considerable one, if my calculations respecting Mr. Spence's working be correct. Every manufacturer of oil of vitriol will bear out my experience, which is this—that the economical production of vitriol is a problem which every man must solve in a great part for himself, and that it depends on a variety of conditions, not exactly the same in many instances; but they may be classed into the chemical, the physical, the practical, and the commercial. The first and second of these are of paramount importance, and have not been sufficiently attended to, or all might arrive at a perfection almost complete; the latter involve the consideration of perfection of apparatus, skilled attention to working, and the varying conditions which regulate supply according to price and demand. In conclusion, I may say that I agree with Mr. Gibbins that there is much difficulty in making acid which has absorbed nitrous compounds give them up completely, as I have detected them in the acid, although in much diminished quantity, after dilution, agitation, and boiling.

I fear I have trespassed already too much on your valuable space, so that I must conclude.—I am, &c.,

DAVID BASIL HEWETT, B.A., T.C.D.

Manchester, April 25th, 1870.

MISCELLANEOUS.

Death of Dr. Magnus, of Berlin.—We learn with great regret that the celebrated physicist, Dr. Heinrich Gustav Magnus, of Berlin, died there on the 4th inst; the deceased was born at Berlin on the 2nd of May, 1802, and took the degree of Ph.D. at Berlin University in 1827, his inaugural dissertation written in Latin bearing title "De Tellurio." In 1834 he was appointed Extraordinary Professor of Natural Philosophy at Berlin University, and in 1845 became Ordinary Professor for the same subject. The deceased largely contributed to extend our knowledge of physical sciences, but owing to the great mass of his various contributions, it is quite impossible to give here even a brief outline of his labours. The deceased was a member of several scientific societies and institutions, and carried on a regular correspondence with the foremost scientific men in the civilised world.

Description of Browning's Automatic Spectroscope.—This instrument is furnished with a battery of six equilateral prisms of dense flint glass; all the prisms are joined together like a chain by their respective corners, the bases being in this manner linked together. This chain of prisms is then bent round so as to form a circle with the apices outwards; the centre of the base of each prism is attached to a radial rod. All these rods pass through a common centre. The prism nearest the collimator, *i.e.*, the first prism of the train, is a fixture. The movement of the other prisms is then in the proportion of 1, 2, 3, 4, and 5, the last or 6th prism moving five times the amount of the second. All these motions are communicated by the simple revolution of the micrometer screw, which is used for measuring the position of the lines in the spectrum, and the amount of motion of each, and of the telescope, is so arranged that the prisms are automatically adjusted to the minimum angle of deviation for the ray under examination. It is easy to test the efficiency of the instrument in this respect. On taking the lens out of the eye-piece of the telescope, the whole field of view is found to be filled with the light of the colour of that portion of the spectrum which the observer wishes to examine; while in a spectroscope of the usual construction, at the extreme ends of the spectrum, just where the light is most required, only a lens-shaped line of light would be found in the field of view. As a consequence of this peculiarity, the violet and deep red ends of the spectrum are greatly elongated, or rather much more of them can be seen than in an ordinary spectroscope, and the H lines, which are generally seen only with difficulty, come out in a marked manner.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, April 18, 1870.

The papers and memoirs relating to chemistry or collateral sciences in this number are:—

Clinorhombic Form of the Red Oxide of Mercury.—M. des Cloizeaux.—The author describes, at great length, the crystallographical shape of this oxide as obtained by a peculiar, but not detailed process, and incidentally mentions, that the *melaconise*, from Cornwall (a native oxide of copper), is, according to Mr. Maskelyne, the only other metallic oxide belonging to the clinorhombic system.

Second Notice relating to the Specific Heat of Water when near its Maximum Specific Gravity.—G. A. Hirn.

Experimental Researches on Gold and its Compounds.—J. P. Prat.—The main features of this lengthy paper are the following:—In order to obtain the best possible solution of gold, the two constituents of the aqua regia, nitro-hydrochloric acid, should be each diluted with their own bulk of water previous to being mixed together; the metal having been dissolved, of course heat is to be applied. The previously quite cooled liquid is neutralised with bicarbonate of potassa; and, next, oxalic acid is added, which causes the reduction of the gold to the metallic state, but in the shape of a very finely-divided powder, which, however, agglutinates by applying heat, so as to become a spongy mass, which may readily be kneaded into shape by the fingers. The author describes the combinations of gold with oxygen and with chlorine—to wit, an intermediate, or olive-coloured oxide, Au_4O_3; a binoxide, AuO_2; a protochloride, sesquichloride, and perchloride (the latter a volatile substance). Among the salient points resulting from the author's researches, the most remarkable is that gold may be directly oxidised and salified by some of the oxacids, and that, in many instances, gold behaves with reagents as other metals do.

Spectrum Analysis of a Sun's Spot.—G. Rayet.

Variations of the Index of Refraction of Water, as Dependent upon its Temperature.—M. Croullebois.

Assay of Silver which contains Mercury.—H. Debray.—This paper, especially interesting to those who have daily to make assays of silver by the moist way, or Gay Lussac's process, is not well suited for abstraction; and it, moreover, appears that the author is unaware of the fact that, some fifteen years ago, Prof. G. J. Mulder pointed out what is here brought forward as something quite new, in his work (published in the Dutch language) "On the Assay of Silver by the Moist Way." The mercury here alluded to is, of course, a comparatively very small quantity, found in metallic silver occasionally.

Iodhydrates and Chlorhydrates of Monobromated Ethylen and Propylen.—E. Reboul.

New Researches on Black Phosphorus.—M. Blondlot.—The author states that, after having given away all he had of black phosphorus prepared by him in 1866 by Thenard's method, he set to work, some short time ago, to prepare a fresh quantity, but did not succeed until he added some mercury and heated the metal along with it. His researches on the nature of the *pigmentum*, as he calls the black phosphorus, prove that it does not contain even the least trace of mercury; and he concludes that it merely acts catalytically in this instance.

Dextrine Insoluble in Water.—M. Musculus.—It appears, from this lengthy paper, that dextrine may be obtained in a state insoluble in water by acting upon starch with either very strong acetic (glacial) acid; or, also, by modifying the action of sulphuric acid and water upon starch. The dextrine separates in the shape of rather bulky granules, which increase in size (they are, however, very small, because their diameter varies from 0·001 to 0·030 m.m.) according to the length of time they are left in the mother liquor, wherein they are formed; these granules are insoluble in cold water, but are suddenly dissolved when they are placed in water at 50°, and they then remain soluble.

Chloronitric and Bromonitric Ethers of Glycerine.—L. Henry.—The author first observes that the only nitric acid compound, as yet known, of glycerine, is the trinitrine of glycerine, a substance of too great notoriety under the misnomer of nitroglycerine. The author next describes, at very great length, the preparation and properties of—

Monochloro-dinitrine, $(C_3H_5)(NO_3)_2Cl$; monochloro-mononitroglycerine—

$$(C_3H_5)ClO+H(NO_3)=(C_3H_5)Cl(HO)(NO_3);$$

monochloro-dinitroglycerine—

$$(C_3H_5)Cl(HO_3)(NO)+H(NO_3)=(C_3H_5)Cl(NO_3)+H_2O;$$

dichloro-mononitrine, $(C_3H_5)Cl_2(NO_3)$, a colourless liquid, almost insoluble in water, but soluble in alcohol and ether (sp. gr. at 10°, 1·465; monochloro-dinitrine, $(C_3H_5)Cl(NO_3)_2$, also a liquid of great density (viz., 1·5112 at 9°).

Direct Combination of Allylic Compounds with Chloride of Iodine and Hypochlorous Acid.—L. Henry.

Formation of Urea by the Action of Permanganate of Potassa on Albumenoid Substances.—A. Béchamp.—The contents of this valuable paper may be summarised thus:—The elimination of urea in the animal body is the result of the oxidation of the albuminous compounds of the blood; and the author proves this by operating with permanganate upon pure albuminous substances, freed purposely from fatty matters and sugar, and kept in solution by means of a weak alkali.

Aurora Borealis seen on the 5th of April last.—L. Sonrel.—From this lengthy paper, we learn that this phenomenon, already alluded to by us last week, was visible over nearly all Europe, and that, wherever it was visible, the magnetic instruments were violently agitated. The author enters into a great many details on this subject, among which the most remarkable is that the Aurora was accompanied, or preceded, for a brief period, by a very disagreeable smell (the quality thereof is not specified), very perceptible, as well at Dinkelsbühl (Bavaria), as at Paris. In high northern latitudes, this phenomenon is often accompanied by a peculiar, somewhat sulphurous, and rather oppressive, smell.

Poisonous Property of some of the Products of the Phenic Acid Series.—P. Guyot.—The accidents caused by such products as coralline, azuline, &c., depend simply upon the mode of preparation employed; for, if excess of aniline or phenol is present, the material becomes poisonous.

Earthquakes and Volcanic Explosions observed in the Netherlands' Indies from the beginning of the 16th century to the present time.—L. de Backer.—This paper, or, rather, chronological enumeration of volcanic eruptions, earthquakes, and other volcanic phenomena, vomiting of mud and boiling water from a series of volcanoes in the Indian Archipelago, begins with the year 1506, and comes down to our days. No portion of the inhabited globe, during its present geological age, has been the scene of such great and continuous volcanic action as that beautiful portion of the globe here alluded to. This paper is a very valuable contribution to our knowledge of the effects of volcanic action in various ways. The number of earthquakes and eruptions noticed (viz., by Europeans, and recorded by them) from 1506 to 1847 alone amounts to 141; and there is, as observed by Dr. Junghun, very great reason to suppose that this number is 50 per cent too low.

The American Journal of Science and Arts, March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Photometric Experiments.—Part I.: On a Simple Form of Photometer for Determining the Amount of Light Reflected by Metallic Surfaces at Different Incidences.—Ogden N. Rood.—Illustrated with woodcuts, without which an abstract would not be understood.

Contributions to the Chemistry of Copper.—T. Sterry Hunt.—Reserved for full reproduction.

Silver Mines of Santa Eulalia, State of Chihuahua, Mexico.—James P. Kimball.—A very interesting contribution to the history of silver mining; also bearing testimony to the enormous mineral wealth of Mexico.

Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences.—F. A. P. Barnard.—This is the report made by the author, as U. S. Commissioner to the last Paris Industrial Exhibition, on this subject.

Norite or Labradorite Rock.—T. Sterry Hunt.

Cause of the Colour of the Water of Lake Leman, Geneva, Switzerland.—A. A. Hayes.—The author's concluding words on this often discussed and investigated subject are—"The negative results of chemical analysis, and the sufficiency of the reflected and refracted light of the sky which is over the water of Lake Leman, led me to the conclusion that the cause of the colour is found in the peculiar hue of the sky, so transmitted to the eye by a colourless water."

On the Potassio-Cobaltic Nitrite known as Fisher's Salt, and some Analogous and Related Compounds.—S. P. Sadtler.—This very lengthy treatise is filled with a large number of formulæ. The author's chief conclusion is that the salt alluded to is essentially a compound having the formula $Co_2 6NO_2+6(KNO)+aq$.

Meteors of November, 1869.—H. A. Newton.

Zeitschrift für Chemie von Beilstein, No. 6, 1870.

This number contains the following original papers:—

On Tetramethyl-Benzol.—P. Jannasch and R. Fittig.—After having entered, at some length, into speculative discussions referring to the possibility of the substitution of more than three atoms of hydrogen in benzol, the authors describe, at great length, the process of preparation whereby they obtained a tetramethyl-benzol, $C_{10}H_{14}=C_6H_2(CH_3)_4$, which substance they have called *durol*, because there may exist several modifications of tetramethyl-benzol. Durol is the only hydrocarbon yet known belonging to the benzol series, which is a solid body at the ordinary temperature of the air. It is crystalline; readily soluble in alcohol, ether, and benzol; fuses about 80°, and boils at between 189° and 191°; is specifically lighter than water; and, when burning, exhibits a very luminous flame. Dinitrodurol, $C_{10}H_{12}(NO_3)_2=C_6(NO_2)_2(CH_3)_4$, is obtained by the action of very strong nitric acid upon durol. Dinitrodurol is also a solid, crystalline body, readily soluble in ether, less readily in benzol and in boiling alcohol, fuses at 205°, and is sublimed without decomposition. Dibromo-durol, $C_{10}H_{12}Br_2=C_6Br_2(CH_3)_4$, a solid substance, very difficultly soluble in alcohol, fusing at 199°, and sublimable without decomposition.

Aceton-Sulpho Acid.—Dr. Bender.—The author prepared this substance from dichloraceton and a solution of neutral sulphite of potassa, yielding aceton-sulpho-potassa—

$$C_3H_5SO_4K=CH_3-CO-CH_2-SO_3K.$$

By treating this salt with dilute sulphuric acid, no sulphurous, nor sulphuric acid, is given off; but the aceton-sulpho acid was not obtained in free state.

Some of the Derivatives of the Toluol Series.—E. Wroblevsky.—This paper might almost be compared to a catalogue. The author enumerates, first, isomeric monochlor-methyl-phenetols, viz.—α methylchlor-phenetol, a fluid boiling at about 220° (sp. gr. at 19°5, 1·127); β methylchlor-phenetol, also a fluid boiling at 220° (sp. gr., 18°). Secondly, isomeric chlor-iod-toluols, viz.—α C_7H_6ClI, a fluid boiling at about 242° (sp. gr., at 17°, 1·716), and is not solidified at −14°; β C_7H_6ClI, again a fluid boiling at 240° (sp. gr. at 19°, 1·770). Thirdly—Paraiod-orthobrom-toluol, C_7H_6BrI; dichlortoluidine, $C_6H_3Cl_2.CH_3$; nitro-dichlortoluol, a fluid exhibiting the smell of nitrobenzol, soluble in alcohol and ether, and boiling at 274° (sp. gr. at 17°, 1·455).

Isomeric Nitro-Bromotoluols and Bromotoluidine.—E. Wroblevsky.—This paper is chiefly a critical review of the labours of a great many chemists who have been engaged in researches on this subject, and, like the foregoing paper, is a catalogue of substances.

On Diethglyoxylic Ether.—A. Schreiber.—Of the substance here alluded to, the preparation and derivation are described at great length. Diethglyoxylic ether, $CH(C_2H_5O)_2COOC_2H_5$, is a very clear, colourless, strongly-refrangible liquid (sp. gr. at 18°, 0·994), miscible with alcohol and ether in every proportion; diethglyoxylic acid amide, $CH(C_2H_5O)_2CONH_2$, is a solid substance crystalline, fusing at 76°5, and readily soluble in water and alcohol.

Conditions of the Formation of the Mono-Sulpho Acids of Naphthaline.—V. Merz and W. Weith.—This paper is not well suited for useful abstraction.

Revue Hebdomadaire de Chimie, April 7, 1870.

Preservation of Beet-Root Leaves for Fodder for Cattle.—M. Mehay.—Under this title, the author describes, at great length, a method of preservation of the leaves alluded to, but also applicable to other leaves of a similar nature, and perhaps to grass, which method consists mainly in the following process:—Into a vessel of some 2 hectolitres' capacity (about 45 gallons) are poured from 2 to 3 decilitres (each decilitre is equal to 0·176 pint, or 6·102 cubic inches) of hydrochloric acid, sp. gr. 1·18 (that is to say, an acid of 38 per cent of ClH at 15°5°); and next there is added to this acid a large quantity (how much is not stated) of water. The fluid is thoroughly mixed, by means of a wooden spatula; and next, 50 kilos. of the leaves, yet attached to the crown part of the root, which is cut off, are placed in this liquid and thoroughly immersed therein. This having been done, the entire mass is heated to the boiling-point, and kept boiling for 10 or 15 minutes; the leaves are taken from the cauldron, by means of wooden forks, and placed on hurdles, so as to admit of the surplus liquid draining off, after which the leaves are fit to be preserved in a manner similar to that in which potatoes, turnips, and the like are kept, by being placed in pits covered inside with straw, and next covered over with the soil of the garden or farm ground. We cannot enter more fully into this subject, which is, however, deserving the attention of agriculturists. The author states that the acid combines with the alkaline salts of the leaves and thus forms chlorides of sodium and potassium; the quantity of acid is too small, moreover, to affect the health of the cattle. It is clear that either iron enamelled cauldrons, or those made of copper, can only be used with open fire; where steam is at hand, well made wooden tanks may serve.

A New Manure.—M. Auvillain.—The author treats residues and offal of fish, first boiling the same, with addition of 1-10th of the weight of the mass of any cheap oil, heating up to from 120° to 140°. By this means, all the water is expelled from the offal, which is next treated with sulphide of carbon, whereby the oil naturally contained in the fish, as well as that which was added, is extracted, leaving a mass quite dry, and containing from 5 to 6 per cent of nitrogen and from 12 to 15 per cent of phosphate of lime.

Production of Petroleum (Paraffin Oils) in the United States.—L. Péaud.—It appears that the quantity produced of the substance alluded to is largely on the increase, since the average daily production amounted, in 1868, to 10,863 barrels, and in 1869 to 13,197 barrels. The stock on the first day of this year was, in the States and Canada jointly, 1,238,000 barrels.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, 1870.

This number contains the following original papers:—

Preparation of Ethylamines on the Large Scale.—Dr. A. W. Hofmann.—This lengthy paper treats on the preparation of ethylamines, by applying thereto the by-products obtained during the manufacture of hydrate of chloral. This material is treated in closed vessels, at 100°, with a concentrated alcoholic solution of ammonia.

Synthesis of Aromatic Acids.—V. Meyer.—This paper is subdivided into the following groups:—Synthesis of benzoic acid; synthesis of isophthalic acid; constitution of substituted benzoic acids.

Contribution to our Knowledge of the Constitution of Camphor.—V. Meyer.—This very lengthy paper, full of complicated formulæ, is not well suited for abstraction. In a foot-note, the author observes that most of the recently published works on organic chemistry quote the melting-point of camphoric acid at 62·5, whereas some six years ago, the researches of MM. Tollens and Fittig proved the melting-point of that acid to be at about 176°; and the author's researches have confirmed this particular.

Crystallised Hydrate of Soda.—O. Hermes.—The author states that, during the cold weather which prevailed at Berlin some two months ago, he had the opportunity of obtaining, from an aqueous solution of caustic soda (sp. gr., 1·365), beautiful crystals of rhombo-prismatic shape, perfectly transparent, fusing at 6°, and containing 30·09 *NaO*. The formula of this compound is, therefore, $NaO+8HO$; or, according to more recent views, $2NaOH+7H_2O$.

Contribution to our Knowledge of the Iodides.—E. Meusel.—The author describes iodide of copper, which he obtained by the slow action of metallic copper upon hydriodic acid, in the shape of faintly greenish yellow-coloured tetrahedrical crystals, which become dark coloured by exposure to light. The author next describes some experiments relating to the action of light on the chlorides, fluorides, iodides, and bromides; and, lastly, gives a review of the various analytical methods in use for the quantitative analysis of insoluble iodides. The author's method is based upon the solubility of the iodides of mercury, lead, silver, and copper in hyposulphite of soda; the metals are precipitated from that solution by hydrosulphuret of ammonium, and all the iodine remains in solution. After removal of the sulphurets of the metals, ammonia is added to the filtrate, and the liquid evaporated, so as to expel the bulk of the sulphur in the shape of sulphide of ammonium. Solution of caustic soda is next added; and, after evaporation to dryness, the saline mass is ignited, next dissolved in a small quantity of water, solution of chloride of iron is added in excess, and the iodine, after having been taken up by iodide of potassium, is estimated by titration.

On those Haloid Compounds which Correspond to Picric Acid and Dinitro-Phenol, and on some Derivatives thereof.—C. Clemm.—Under the above title, this very lengthy paper treats on chloro-nitro-benzol, chloro-dinitro-benzol, bromo-dinitro-benzol, and on nitro-derivatives of the haloid compounds here named.

On so-called Chloraceten.—A. Kekulé and Th. Zincke.—After referring, at some length, to the researches of various scientific chemists who have been occupied with this subject, the authors, in their lengthy monograph, give a series of experiments, and come to the conclusion that chloraceten is simply a mixture of aldehyde and paraldehyde, containing hydrochloric acid or chlorocarbonic gas.

Condensation of Aldehydes.—A. Kekulé.—Not suited for any useful abstraction.

Products of the Oxidation of Paraffin.—E. Willigk.—This paper, a preliminary notice, contains the description of a series of experiments, whereby pure paraffin, treated at a high temperature with a mixture of nitric and sulphuric acids, is made to yield materials which belong to the series of fatty acids. The author's researches on this subject are not, however, quite complete.

No. 4.

Contains—

Products of Distillation of Coal-Tar which Boil at a High Temperature.—C. Graebe and C. Liebermann.—The authors state that they obtained, from a tar distillery at which the distillation is pushed till a coke only remains, a solid, lemon-yellow coloured, fatty-looking material, fusing at 150°, while its boiling-point is higher than that of mercury. This material was soon recognised by the authors to be a mixture of various substances, but chiefly made up of chrysen, which, after having been purified, was found to fuse at from 245°—248°, and difficultly soluble in alcohol, ether, and sulphide of carbon, a little more readily soluble in boiling anhydrous acetic acid and in benzol. The authors have studied, also, some of the products of oxidation of chrysen, and among these a body called chrysochinon, $C_{18}H_{10}O_2$. The formula of chrysen is $C_{18}H_{12}$.

Betaine and its Constitution.—C. Schiebler.—This lengthy paper is illustrated by diagrams, and, therefore, like the following—

Identity of Oxyneurine and Betaine—Dr. O. Liebreich—Not suited for abstraction.

Chlorophosphide of Nitrogen.—H. Wichelhaus.—This paper contains a review of the labours of various authors on this subject.

Description of an Improved Shape and Arrangement of Hofmann's Apparatus for the Determination of Vapour Densities.—H. Wichelhaus.—This paper is illustrated by a woodcut, essentially required to the proper understanding of the contents.

Our Present Knowledge of the Mineralogico-Chemical Properties of Meteorites.—C. Rammelsberg.—A lengthy essay, chiefly of mineralogical interest.

Contribution to the History of the Platinum Bases.—Charles Gordon.—A review of the labours of Reiset, Magnus, Raewsky, and others on this subject.

On Paytine.—O. Hesse.—Under this name, derived from the seaport of Payta (Peru), the author describes a new alkaloid, found by him in the cinchona bark shipped from the place alluded to. Paytine, $C_{21}H_{24}N_2O+H_2O$, is readily soluble in ether, benzol, chloroform, and alcohol, but very difficultly soluble in water; fuses at 156°; exhibits an alkaline reaction to test-paper, but does not very readily form salts, nor is it quite neutralised with acids. On being heated with soda-lime, paytine yields a substance, paiton, free from nitrogen.

New Organic Phosphorus Compound.—L. Darmstädter and A. Henniger.—The author describes a material accidentally discovered by him, and found to be cyan-ethyl-phosphide, C_3H_5NP. In 100 parts —C, 41·37; H, 6·90; N, 16·09. Since the quantity obtained was very small, no other experiments could be made with this substance.

Solid Crotonic Acid.—A. Claus.

Thebolactic Acid.—After referring to Dr. Stenhouse's labours on this subject, the author states that, having obtained from Messrs. Smith, morphine manufacturers, a quantity of the thebolactate of lime, he instituted therewith a series of experiments, described at length, with the view of ascertaining the truth of the statement that thebolactic acid is identical with lactic acid; and, as far as the author's researches, not yet quite finished, go, this view is confirmed.

Chemical Constitution of Uric Acid and its Derivatives.—Dr. H. Kolbe.—A lengthy monograph, filled with a very large number of formulæ.

Thermo-Chemical Researches on the Phenomena of Neutralisation and Basicity (Basicität) of Acids.—J. Thomsen.—A lengthy paper, containing a series of tabulated forms.

Basicity and Rational Formulæ of Hydrosulphuric Acid.—J. Thomsen.

Preparation of Acetones from Mercuro-Diphenyl.—R. Otto.—Only a series of lengthy formulæ.

Contribution to the History of Phenyl-Acetic Acid.—Br. Radziszewsky.—Nitrile of phenyl-acetic acid is a limpid, colourless liquid, boiling at 229°; sp. gr. at 8°, 1·0155. When this fluid is heated with hydrochloric acid it is converted into chloride of ammonium and phenyl-acetic acid. The nitrile alluded to yields, with nitric acid of 1·5 sp. gr.—A mono-nitrited derivative, $C_6H_4(NO_2)CH_2CN$, a solid crystalline compound, fusing at 114°; diphenyl-aceton—

$$C_6H_5-CH_2-CO-CH-C_6H_5,$$

obtained by the dry distillation of phenyl-acetic acetate of baryta, is, after being purified, a crystalline substance, soluble in alcohol, fusing at 30° and boiling at 320°; phenyl-aceton, $C_6H_5-CH_2-CO-CH_3$, is, when pure, a pleasant smelling fluid, boiling at 215°, and having, at 3°, a sp. gr. of 1·010. This fluid yields, on being first treated with chloride of phosphorus, and next with an alcoholic solution of potassa, in sealed tubes, a substance which, the author says, appears to be a hydrocarbon.

No. 5.

This number contains the following original papers and memoirs:—

Modifications of Sulphuric Anhydride.—Schultz-Sellack.—There exist two modifications of the anhydride of sulphuric acid, viz.—α anhydride, solidifying at +16°, forming lengthy colourless prisms, which fuse at the same temperature, and boil at 46°. β sulphuric anhydride, formed from the former at temperatures below 25°; its crystals are needle-shaped; it fuses above 50°, and is then re-converted into the α variety.

Derivatives of Trinitro-Toluol and Toluylen-Diamine.—F. Tiemann.—This lengthy paper contains the following sections:—Nitro-toluylen-diamine—

$$C_7H_9N_3O_2=C_7H_5\overset{II}{\left.\begin{matrix}(NO_2)\\H_4\end{matrix}\right\}}N_2;$$

brom-diacettoluylen-diamine—

$$C_{11}H_{13}BrN_2O_2=C_7H_5\overset{II}{Br}\left\{\begin{matrix}NHC_2H_3O\\NHC_2H_3O\end{matrix}\right.$$

monacettoluylen-diamine; dibrommonacettoluylen-diamine; toluylen-oxametan.

Di- and Tri-Nitrited Benzoic Acids.—F. Tiemann and W. E Judson.

Contribution to our Knowledge of the Derivatives of Xylidine.—B. Genz.—Sub-divided into sections on—Monobrom-xylidine; aceto-bibrom-xylidide; bibrom-xylidine; xylyl-carbamide; dixylyl-carbamide; dixylyl-oxamide; dixylyl-guanidine.

Products of the Decomposition of Hæmoglobine.—F. Hoppe-Seyler.

Contribution to our Knowledge of Azo Compounds (Azoverbindungen).—A. Kekulé and C. Hidegh.

Quantivalence of Sodium.—O. P. Köhler.—This paper is written as a reply to Professor Wanklyn's papers on this subject published in the CHEMICAL NEWS.

Some of the Constituents met with in the Fruits of the Cerasus Acida, Borckh.—F. Rochleder.

The Society for the Promotion of Industry in Prussia has published in this number that portion of its programme for competitive essays which relates to chemistry. The silver medal of the Society (or its value in money) and a sum of £120 will be given to him who hands in to the Society the description of an improved (and, by practica

experience, found to answer) coke oven-construction, whereby coke of first-rate quality is produced and the products of the volatilisation economically condensed. The Society's silver medal (or its value), and, moreover, a premium of £75, for the best method of quantitative estimation of phosphorus in iron ores, pig-iron, steel, and wrought-iron. The following conditions must be complied with:—The result must be obtained in half an hour—that is to say, this time to be reckoned, if the assay is by the wet way, from the moment the substance is dissolved; if by the dry way, from the moment after the weighing off of the previously-pulverised material. The results must be correct—within 0·01 per cent of phosphorus, when the substance under investigation contains 90 per cent of iron and upwards; within 0·02 per cent for from 75 to 90 per cent of iron; within 0·05 per cent for from 50 to 75 per cent of iron; within 0·1 per cent for from 20 to 50 per cent of iron. The method need not apply to substances containing less than 20 per cent of iron.

NOTES AND QUERIES.

Detection of Strychnine.—(Reply to "Alpha.")—Stas's method will be found in Fresenius's "Qualitative Analysis," p. 243.—A. V.

Drop Black.—I would like to know the method of preparing the substance sold under the names of drop black and imperial drop black. I cannot find any information in books regarding it.—P. H.

Ozone.—Upon examining the contents of some bottles in which N had been prepared by the slow oxidation of iron filings, I found abundant evidence of ozone, both by smell and by the ordinary starch test.—T. B.

Latent and Sensible Heat.—(Reply to "Compound.")—It would be very difficult, if not altogether impossible, to estimate the amount of heat you allude to; but the cause of it is that a chemical combination takes place, attended by the phenomena you allude to; and that this explanation holds good has been proved by Dr. J. H. Croockewit, who, some twenty years ago, made a series of experiments, on a sufficiently large scale, on the metallic alloys. His researches have been published as a separate Dutch work; but, as far as our recollection goes, the author was not able to estimate the amount of heat set free during the sudden combination of the metals you allude to. The cause of this failure is the obvious fact of the want of proper means of estimating high temperatures with sufficient accuracy.

Pyro-Electric Gilding.—In your issue of the 14th inst., I see a quotation from the *Bulletin de la Societe d'Encouragement pour l'Industrie Nationale* (No. 206, February, 1870), to this effect:—"*Pyro-Electric Gilding Invented by M. Masselotte, to whom a Prize of £20 has been given.*—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen." I have been practising this system of gilding and silvering now for over five years under this very title, and was the first to invent the process and used the title. In 1865, I patented this method in France; and in 1868 I patented an improvement on this method in France. M. Masselotte may not have seen my specification, but using the exact title looks suspicious.—J. BAYNES THOMPSON, Electro-Metallurgist, Pyro-Plater, &c.

[By referring to the original report, of which we gave an abstract, Mr. Thompson could at once see if the two processes are similar.—ED. C. N.]

Sulphur in Coal-Gas.—The following note of the formation and condensation of sulphuric acid by the combustion of sulphur compounds in coal-gas in a common fish-tail burner shaded by an ordinary ground-glass globe may, perhaps, interest some of your readers:—Having occasion to take down a gas globe, I noticed a number of brown drops of liquid scattered over its internal surface; on collecting and testing them, they were found to consist of pretty concentrated sulphuric acid, the comparatively high degree of concentration being due to the great temperature acquired by the globe, the heat being far greater than the hand could bear. The brown colour was, doubtless, produced by the carbonisation of organic dust. Also two or three strips of copper, placed over the mouth of the globe to support a shade, were found to be coated with anhydrous cupric sulphate. From the short time which had been taken in the production of the acid (a fortnight, the gas burning for about three hours of an evening, at the rate of 5 ft. an hour), I should think the gas was rather too rich in sulphur to be an unmitigated good to the consumer.—ARCHD. LIVERSIDGE.

MEETINGS FOR THE WEEK.

MONDAY, May 2nd.—Medical, 8.
—— London Institution, 4.
—— Royal Institution, 2. Annual Meeting.
TUESDAY, 3rd.—Institution of Civil Engineers, 8.
—— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."
WEDNESDAY, 4th.—Society of Arts, 8.
THURSDAY, 5th.—London Institution, 7.30.
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Royal Institution, 3. Prof. Tyndall, "On Electricity."
FRIDAY, 6th.—Geologists' Association, 8.
—— Royal Institution, 8. Mr. Proctor, "Star Grouping, &c."
SATURDAY, 7th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

MANUAL OF CHEMISTRY FOR THE SUMMER SESSION OF THE MEDICAL SCHOOLS:

Including Analysis, Chemical Toxicology, Directions for Examining Morbid Urine, Urinary Sediments and Calculi, and the Chemistry of the British Pharmacopœia.

CHEMISTRY: GENERAL, MEDICAL, AND PHARMACEUTICAL.

BY JOHN ATTFIELD, PH.D., F.C.S.,

Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain; many years Demonstrator of Chemistry at St. Bartholomew's Hospital.

The Lancet.—"It contains a most admirable digest of what is specially needed by the medical student in all that relates to practical chemistry, and constitutes for him a sound and useful text-book on the subject. . . . . We commend it to the notice of every medical, as well as pharmaceutical, student. We only regret that we had not the book to depend upon in working up the subject of practical and pharmaceutical chemistry for the University of London, for which it seems to us that it is exactly adapted. This is paying the book a high compliment."

The Chemical News.—"Dr. Attfield's book is written in a clear and able manner; it is a work *sui generis* and without a rival; it will be welcomed, we think, by every reader of the 'Pharmacopœia,' and is quite as well suited for the medical student as for the pharmacist."

The Pharmaceutical Journal.—"It is almost the only book from which the medical student can work up the pharmacopœial chemistry required at his examinations."

Medical Times and Gazette.—"A valuable guide to practical medical chemistry, and an admirable companion to the 'British Pharmacopœia.' It is rare to find so many qualities combined, and quite curious to note how much valuable information finds a mutual interdependence."

The British Medical Journal.—"At page 350 of the current volume of this journal, we remarked that 'there is a sad dearth of (medical) students' text-books in chemistry.' Dr. Attfield's volume, just published, is rather a new book than a second edition of his previous work, and more nearly realises our ideal than any book we have before seen on the subject."

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JOHN VAN VOORST, 1, PATERNOSTER ROW.

THE CHEMICAL NEWS.

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ON THE

ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-PHOSPHATE OF MAGNESIA.

BY THOMAS R. OGILVIE.

THE estimation of phosphoric acid in minerals containing fluorine, oxide of iron, and alumina, is a matter of considerable difficulty.

In the method recommended by Church, in his "Laboratory Guide" (p. 50), the first step is to dissolve the mineral in acid and evaporate the solution to dryness. Other authorities also state that the acid solution should be brought to dryness before proceeding to separate the lime.

Some analysts, however, neglect this part of the process, from the impression that it has no influence on the estimation of the phosphoric acid, and that it is only necessary when the siliceous matter is required for a full analysis. I am not aware that any experiments have been published to show that this impression is an erroneous one; the following, perhaps, will be sufficient:—

(1.) A gramme of Cambridge coprolites was dissolved in moderately-strong hydrochloric acid, evaporated to dryness, the residue again dissolved in acid, the lime separated with oxalate of ammonia, citric acid added to hold up oxide of iron and alumina, the solution made alkaline with ammonia, and the phosphoric acid precipitated with "magnesia-mixture." A perfectly granular precipitate was obtained, which, after standing for twelve hours, was washed, dried, ignited, and weighed, and found to be equivalent to 47·44 per cent tribasic phosphate of lime.

(2.) Another gramme of the same coprolites was treated in exactly the same way, with the exception that the acid solution was *not* brought to dryness. The ammonio-phosphate of magnesia, as it gradually formed, presented the usual appearance; but, when stirred up after a few minutes, a white flocculent body was also observed. After standing for the usual time, the whole precipitate was collected, washed, dried, ignited, and weighed, and gave 53·04 per cent phosphate of lime.

(3.) A third gramme was treated as in (2), with the difference that, after the addition of citric acid, the solution was made alkaline with ammonia, and allowed to stand. In a short time, a white flocculent precipitate formed, which was filtered, washed, dried, ignited, and weighed.

To the clear ammoniacal filtrate, "magnesia-mixture" was added; and a granular precipitate, free from any flocculent matter, was obtained, equivalent to 47·20 per cent phosphate of lime. This closely corresponds with the result (viz., 47·44 per cent) got in (1) by evaporating to dryness.

The flocculent precipitate got by ammonia weighed 4·05 per cent. Had it not been removed, it would have been taken as ammonio-phosphate of magnesia, and, as such, been equivalent to 5·66 per cent phosphate of lime; this, added to 47·20 per cent, gives 52·86 per cent, against 53·04 per cent found in (2) by weighing the flocculent precipitate along with the ammonio-phosphate of magnesia.

These experiments were repeated with another sample of Cambridge coprolites, and with similar results.

(4.) A gramme was dissolved in acid, and brought to dryness, and the phosphoric acid estimated as ammonio-phosphate of magnesia. A result equal to 52·36 per cent phosphate of lime was found.

(5.) Another gramme was treated in the same way, but not brought to dryness. A mixed granular and flocculent precipitate was got, which, on being weighed and calculated as pure pyro-phosphate of magnesia, gave 57·65 per cent phosphate of lime.

(6.) A third gramme was proceeded with as in (3). The solution, after the addition of citric acid, was made alkaline with ammonia, and the flocculent precipitate which formed was separated and weighed. "Magnesia-mixture" was then added to the filtrate; and a granular precipitate was obtained equal to 52·78 per cent phosphate of lime, corresponding to 52·36 per cent found in (4) by bringing to dryness. The separated flocculent precipitate, weighed as pyrophosphate of magnesia, gave 4·47 per cent phosphate of lime; and this, added to 52·78 per cent, got after separating the flocculent matter, gives 57·25 per cent, which agrees with the result (viz., 57·68 per cent) got in (5) by weighing the granular and flocculent precipitates together.

In these experiments, care was taken that the lime was perfectly separated, and that sufficient citric acid was present to hold up oxide of iron and alumina.

The precipitate which forms on the addition of ammonia to the citric acid solution when the mineral has not, at the outset of the process, been brought to dryness, consists of silica, alumina, and sesquioxide of iron, as silicate, and, when carefully washed, is free from phosphoric acid. In the case of sombrerite, some ammonio-phosphate of magnesia would also come down, owing to the presence of a considerable quantity of magnesia in that mineral. But, with coprolites and other phosphatic minerals, which contain only minute quantities of magnesia, neither phosphoric acid nor magnesia is found, unless the flocculent precipitate is not filtered from the solution for a few hours.

All phosphatic minerals which contain fluorine, oxide of iron, and alumina, give this precipitate. Thus, a sample of—

	Gave a flocculent precipitate weighing Per cent.	Calculated as $3CaOPO_5$.
Charleston phosphate	2·40	3·35
Osteolite	2·45	3·45
Rhenish phosphate	3·25	4·54
Bedford coprolites	3·80	5·31
Suffolk coprolites	4·50	6·28

These results, of course, vary in different samples.

Those minerals containing fluorine, and only a trace of oxide of iron and alumina, such as Canadian apatite and Spanish phosphorite, give no appreciable flocculent precipitate. A sample of sombrerite was also examined, but, as it was exceptionally free from oxide of iron and alumina, it gave no flocculent precipitate.

It may be mentioned that, when coprolites, or other ferruginous phosphatic mineral, is moistened with sulphuric acid, gently heated, and the fluo-silicic acid which forms driven off, then dissolved in hydrochloric acid, and the lime removed without the solution being brought to dryness, no flocculent precipitate is got. And neither do "superphosphates" which have been prepared from these minerals give a precipitate.

It would thus seem that, in the analysis of the majority of the phosphatic minerals at present in use by manure manufacturers, special care must be taken to obtain a pure and perfectly granular precipitate of ammonio-phosphate of magnesia, either by evaporating the acid solution to dryness, or by separating the precipitate which forms on the addition of ammonia to the solution containing citric acid; otherwise an erroneously high result is got.

Shaw's Water Chemical Works, Greenock,
April 27th, 1870.

ON A

CAUSE OF ERROR IN ELECTROSCOPIC EXPERIMENTS.*

By Sir CHARLES WHEATSTONE, F.R.S.

To arrive at accurate conclusions from the indications of an electroscope or electrometer, it is necessary to be aware of all the sources of error which may occasion these indications to be misinterpreted.

In the course of some experiments on electrical conduction and induction which I have recently resumed, I was frequently delayed by what at first appeared to be very puzzling results. Occasionally I found that I could not discharge the electrometer with my finger (or only to a certain degree), and that it was necessary, before commencing another experiment, to place myself in communication with a gas-pipe which entered the room. How I became charged I could not at that time explain; the following chain of observations and experiments, however, soon led me to the true solution.

I was sitting at a table not far from the fire-place, with the electrometer (one of Peltier's construction) before me, and was engaged in experimenting with discs of various substances. To ensure that the one I had in hand (which was of tortoiseshell) should be perfectly dry, I rose, and held it for a minute before the fire. Returning, and placing it on the plate of the electrometer, I was surprised to find that it had apparently acquired a strong charge, deflecting the index of the electrometer beyond 90°. I found that the same thing took place with every disc I thus presented to the fire, whether of metal or any other substance. My first impression was that the disc had been rendered electrical by heat, though it would have been extraordinary that, if so, such a result had not been observed before; but, on placing it in contact with a vessel of boiling water, or heating it by a gas-lamp, no such effect was produced. I next conjectured that the phenomenon might arise from a difference in the electrical state of the air in the room and that at the top of the chimney; and, to put this to the proof, I adjourned to the adjacent room, where there was no fire, and, bringing my disc to the fire-place, I obtained precisely the same results. That this conjecture, however, was not tenable was soon evident, because I was able to produce the same deviation of the needle of the electrometer by bringing my disc near any part of the wall of the room. This seemed to indicate that different parts of the room were in different electrical states; but this, again, was disproved by finding that, when the positions of the electrometer and the place where the disc was supposed to be charged were interchanged, the charge of the electrometer was still always negative. The last resource was to assume that my body had become charged by walking across the carpeted room, though the effect was produced even by the most careful treading. This ultimately proved to be the case; for, resuming my seat at the table, and scraping my foot on the rug, I was able, at will, to move the index to its greatest extent.

Before I proceed further, I may state that a gold-leaf electrometer shows the the phenomena as readily.

When I first observed these effects, the weather was frosty; but they present themselves, as I have subsequently found, almost equally well in all states of the weather, provided the room be perfectly dry.

I will now proceed to state the conditions which are necessary for the complete success of the experiments, and the absence of which has prevented them from being hitherto observed in the striking manner in which they have appeared to me.

The most essential condition appears to be that the boot or shoe of the experimenter must have a thin sole, and be perfectly dry; a surface polished by wear seems o augment the effect. By rubbing the sole of the boot against the carpet or rug, the electricities are separated; the carpet assumes the positive state, and the sole the negative state. The former, being a tolerable insulator, prevents the positive electricity from running away to the earth; while the sole of the foot, being a much better conductor, readily allows the charge of negative electricity to pass into the body.

So effective is the excitation that, if three persons hold each other by the hands, and the first rubs the carpet with his foot while the third touches the plate of the electrometer with his finger, a strong charge is communicated to the instrument.

Even approaching the electrometer by the hand or body, it becomes charged by induction at some distance.

A stronger effect is produced on the index of the instrument if, after rubbing the foot against the carpet, it be immediately raised from it. When the two are in contact, the electricities are in some degree coerced or dissimulated; but, when they are separated, the whole of the negative electricity becomes free, and expands itself in the body. A single stamp on the carpet, followed by an immediate removal of the foot, causes the index of the electrometer to advance several degrees; and, by a reiteration of such stamps, the index advances 30° or 40°.

The opposite electrical states of the carpet and the sole of the boot were thus shown:—After rubbing, I removed the boot from the carpet, and placed on the latter a proof-plate (*i.e.*, a small disc of metal with an insulating handle), and then transferred it to the plate of the electrometer: strong positive-electricity was manifested. Performing the same operation with the sole of the boot, a very small charge was carried, by reason of its ready escape into the body.

The negative charge assumed by sole-leather, when rubbed with animal-hair, was thus rendered evident:—I placed on the plate of the electrometer a disc of sole-leather, and brushed it lightly with a thick camels'-hair pencil. A negative charge was communicated to the electrometer, which charge was principally one of conduction, on account of the very imperfect insulating power of the leather.

Various materials, as india-rubber, gutta-percha, &c., were substituted for the sole of the boot; metal plates were also tried. All communicated negative electricity to the body. Woollen stockings are a great impediment to the transmission of electricity from the boot; when these experiments were made, I wore cotton ones.

When I substituted for the electrometer a long wire galvanometer, such as is usually employed in physiological experiments, the needle was made to advance several degrees.

At the meeting of the British Association, at Dublin, in 1857, Professor Loomis, of New York, attracted great attention by his account of some remarkable electrical phenomena observed in certain houses in that city. It appears that, in unusually cold and dry winters, in rooms provided with thick carpets, and heated by stoves or hot-air apparatus to 70° F., electrical phenomena of great intensity are sometimes produced. A lady, walking along a carpeted floor, drew a spark ¼ inch in length, between two metal balls, one attached to a gas-pipe, the other touched by her hand; she also fired ether, ignited a gas-light, charged a Leyden jar, and repelled and attracted pith balls similarly or dissimilarly electrified. Some of these statements were received with great incredulity at the time both here and abroad; but they have since been abundantly confirmed by the Professor himself and by others (see Silliman's *American Journal of Science*, July, 1858).

My experiments show that these phenomena are exceptional only in degree. The striking effects observed by Professor Loomis were feeble, unless the thermometer was below the freezing-point, and most energetic when near zero, the thermometer in the room standing at 70° F. Those observed by myself succeed in almost any weather, when all the necessary conditions are fulfilled. Some of

* Read before the Royal Society, April 28th, 1870.

these conditions must frequently be present, and experimentalists cannot be too much on their guard against the occurrence of these abnormal effects: I think I have done a service to them, especially to those engaged in the delicate investigations of animal-electricity, by drawing their attention to the subject.

PLATINISED LOOKING-GLASSES.

By C. WIDEMANN.

THE glass, being prepared by the usual method, is soaped, polished, and cleansed. The Platinised-Glass Works at Wailly-sur-Aisne, France, where this new industry is carried on, possesses highly-improved polishing-tables, so much so that the polishing operation occupies only three hours. At the St. Gobain Works, this operation requires a manipulation of forty-eight hours.

After the cleaning operation, the glass is carried into the platinising-shop, and the composition giving the metallisation is applied to the glass by means of a brush. The plate is placed vertically, and receives the platinising liquid to a convenient thickness: it is first applied from top to bottom, then from left to right, and at last from right to left; by these means the oily coating is equalised. This composition, containing a large quantity of essence of lavender, spreads itself instantly over the surface, drying slowly and without any running. Great care must be taken to avoid all dampness and dust; dampness would crisp and wrinkle the surface, and the dust would destroy the regularity of the work, as every grain of dust absorbs liquids concentrically, and thus deprives the surrounding parts.

The platinising composition needs nothing else, to be perfect, than great cleanliness on the part of the operator.

In making the platinising liquid, the following materials are used:—100 grms. carefully-laminated platina, in very thin sheets, are taken; it is soaped, in order to remove all the grease that might have accumulated during the laminating operation; it is then dissolved in an aqua regia, composed of 400 grms. nitric acid for 1000 grms. pure hydrochloric acid; it is heated, by means of a sand-bath, to dryness, care being taken not to decompose the chloride by excessive heat; it is then crushed in a porcelain or glass mortar, and laid on a grinding glass-plate, where it is mixed with small quantities at a time of essence of lavender (rectified), care being taken not to work at too high temperature, or the reaction would take place on this glass plate. Having added about 1400 grms. of essence of lavender, the mixture is collected in a porcelain dish, and left to itself for eight days without the least disturbance. The liquid is next decanted, filtered, and left again, for six days; and this filtered liquid must then be about 5° Baumé at the acid test. For the above quantity, 25 grms. litharge and 25 grms. borate of lead are taken, and ground to an impalpable powder, with 8 to 10 grms. essence of lavender. This last mixture is then added and stirred with the platinising liquid. It is then applied as above described, care being always taken to avoid dampness and dust.

As soon as the glass plate to be platinised has received the metallic coat, and is sufficiently dry, it is placed in muffles, formed of a frame of cast-iron, tongued and grooved, and the parts of which slide in each other.

The fire-place is placed at the back of the oven, which arrangement gives free access to the door through which the glass is placed in the oven. Movable frames are placed in the cast-iron frame, and receive the glasses to be heated, maintaining them in a parallel and vertical position. Hooks, properly constructed, support a large number of these frames. Also, movable sheets allow glasses of different sizes to be placed in these frames.

The vertical and longitudinal section of the oven is a long parallelogram, and its cross section is a square. The cooking is regular, and the accidents of fire are regulated by registers or iron grates in the posterior and anterior part of the oven. A series of muffles are placed under the dome.

The platinised mirror thus obtained is of great solidity, and no metal is more resistant to the influence of atmospheric agents. Even when a mirror is thrown into a great fire, at the temperature at which the glass melts, it will have retained its metallic surface. The mirrors do not give false tints to coloured objects, as the common mercury-alloy does.

The reflection being obtained by the anterior surface, there exists no double reflection; but what is still more remarkable is that the substitution of platina for tin and mercury is that it allows any kind of glass to be transformed into a mirror. The vitreous matter is polished on one face only, and, having been submitted to the platinising process, reflects images without distortion from the surface of the metal itself.

Let us now come to the actual process in use. The following conditions had to be fulfilled:—

After having suppressed the use of mercury, the glass was to be perfectly colourless, and deprived of every defect. The cost had to be reduced, or the old routine would not give place to progress. Not only has Dodé suppressed the use of mercury, but he has, by his improvement, been able to make better mirrors; for he hides, by his process, the faults in the glass plates, and obviates half the work of planing and polishing. In order to obtain this result, it was necessary to apply the reflecting surface on the front of the glass plate, and not at the posterior surface.—*Scientific American.*

ON THE ABSORPTIVE POWER OF SOIL.*

By ROBERT WARINGTON, F.C.S.

THE chemistry of soil is a branch of science at present but imperfectly investigated, and confessedly full of difficulties. In its full meaning, it implies an acquaintance with all the various forms of matter contained in soil, and also a perfect knowledge of their behaviour under the various conditions to which soil is liable. The chemist has comparatively little difficulty in analysing a soil. He can pull it to pieces, and determine with considerable accuracy the proportion of the various elements which together compose it; but the results thus obtained are only a very partial help in the study of the chemical properties of soil. The analysis fails to tell him in what relation the various elements stood to each other in the original soil, in what forms of combination they actually occurred. The chemist is thus, at starting, only imperfectly acquainted with the compounds present in any particular soil, the chemical properties of which he is about to study. But this is not the only difficulty under which he labours,—he is ignorant to a very considerable extent of the properties and behaviour of those substances which he believes to be present. The constituents which make up the bulk of his soil may be classed under certain heads,—as water, quartz, silicates, hydrated oxides, carbonates, and humus; but how little is known respecting the behaviour of most of these substances under the conditions met with in soil! What is their action towards the various salts, which form so important a part of plant-food? What is their action towards the various gases of the atmosphere? What is their behaviour in the presence of decaying vegetable or animal matter? What, again, is their influence on each other when present in different proportions? The subject has been too little studied to allow of any but imperfect answers being given to these questions. It naturally follows, from this immature condition of the science, that, while several of the properties of

* *Practice with Science*, vol. ii.

soil have been very ably investigated, the origin and cause of these properties have been but indistinctly traced: one investigator ascribes a phenomenon to the action of one of the ingredients of soil, while another sees, in the same phenomenon, the sole action of a different soil-ingredient.

In the present paper, we propose to confine our attention to one of the best known properties of soils—their remarkable faculty of withdrawing certain substances from their solution in water.* The subject has received attention only in the last twenty years. It has, perhaps, been more fully investigated than any other part of the chemistry of soil, and richly deserves further study. Did we thoroughly understand it, the whole subject of the condition of plant-food within the soil would be at our command; we might then hope to be able to discriminate between available and non-available plant-food, and agriculture would gain largely by the increase to our knowledge.

Many an observant farmer must have noticed, long before agricultural chemistry had its birth, that soil has the property of removing very quickly the odour and colour of liquid manure; but the observation, however intelligent, resulted in no permanent addition to our stock of knowledge. Near to our own day, two thoughtful men noticed this fact, and fortunately each of these observers was acquainted with a chemist. Mr. H. S. Thompson, in 1845, made a few careful experiments on the subject, with the assistance of Mr. Spence, a chemist at York, but did not publish his results till five years later. Mr. Huxtable, a short time after, drew the attention of Professor Way to the same subject; the result was the publication, in 1850, of Way's now classical paper "On the Power of Soils to Absorb Manure,"† followed by two other papers, in 1852 and 1855. Numerous chemists have since made researches on the subject, especially in Germany, and the subject is still being vigorously prosecuted. We propose to give some account of the results arrived at, and the principal opinions held respecting this property of soils, and also a short description of some experiments recently made at the Royal Agricultural College upon the same question.

Way treated various soils and clays with solutions of ammonia, and with solutions of carbonate, sulphate, and chloride of ammonium. He repeated the same experiments with potash, and with carbonate, sulphate, nitrate, and chloride of potassium. Experiments were also made, though fewer in number, with salts of sodium, calcium, and magnesium. He found that, when solutions of ammonia, potash, or of their carbonates, were filtered through 10 or more inches of soil, these salts were absorbed to such an extent that their presence could not be detected in the filtered liquid till a very considerable amount of the salt-solution had been applied, and the soil had, in fact, become partially saturated. In the case of the carbonates, the carbonic acid, as well as the base of the salt, was generally retained by the soil; but, when the other salts of ammonium and potassium were applied in the same manner, the base only of the salt was absorbed, and the filtered liquid contained the nitric acid, sulphuric acid, and chlorine, united with calcium‡ derived from the soil or clay experimented upon. The salts of sodium were acted on by soil in the same manner as the salts of ammonium or potassium, but the absorption was less energetic. Solutions of caustic lime, and of bicarbonate of calcium, were deprived of their calcium by passing through soil; magnesium was also absorbed from solutions of its salts. In an experiment with a solution of phosphate of sodium, the phosphoric acid was found to be perfectly retained by the soil. A solution of superphosphate was also completely deprived of its phosphoric acid by filtering through soil. From all these experiments, Way came to the conclusion that the affinity exhibited by soils was directed solely towards basic substances. Sulphuric, hydrochloric, and nitric acids were apparently not absorbed from their salts; and he was of opinion that the retention of carbonic and phosphoric acids by soil was due only to their forming insoluble compounds with the lime of the soil. The absorption of bases from the solutions of their sulphates, chlorides, nitrates, &c., he considered was brought about through the decomposition of these salts by the lime in the soil; the lime, by combining with the acid, left the base free for absorption.

Way further determined the amount of the absorption in the case of several soils and clays; and, in these experiments, instead of filtering the solution of salt through the soil, a weighed portion of the soil was shaken with a known quantity of the salt-solution, and the extent of the absorption determined from the amount of salt showed by analysis to have disappeared from the solution. This method of experiment has been generally adopted by succeeding investigators, though, as we shall see further on, it is not without its disadvantages.

Before discussing the explanations that have been offered by Way and succeeding investigators of these remarkable properties of soil, it will be well to put the reader in possession, as far as possible, of the facts connected with soil-absorption, which have been gradually accumulated.

All soils seem to possess this property of removing certain bases and acids from solution. The faculty is not confined to one class of soil, but is enjoyed by all the varieties of clay, marl, loam, light sand-soil, and peat-soil. The faculty is not, however, possessed by all soils in the same degree, some soils exhibiting a very considerable absorptive power, while the capabilities of others in this direction are but small. Again, soils differ in their behaviour towards the different classes of salts: two soils that are equal in absorptive power for free ammonia are not, perhaps, equal in their power of absorbing sulphate of ammonium. It was shown, in Way's experiments, that the lime contained in soil took an important part in the action of soil upon sulphates, nitrates, and chlorides—a fact which has been abundantly confirmed by other researches. We can, therefore, easily understand that the presence or absence of lime, and of substances playing a similar part, must materially affect the absorptive power of soil for certain salts.

It must not be supposed that the salts named above, as used in Way's research, are the only substances which soil is capable of absorbing. If sewage or liquid manure be passed through soil, it will be found that nearly the whole of the organic matters held in solution have been removed—the offensive sewage will have become clear water. Here we have a large class of bodies, of which chemists know very little, which soil is clearly capable of absorbing. Again, there can be no doubt that the same action which determines the absorption of potassium or sodium would equally determine the absorption of the rarer alkaline metals—lithium, cæsium, and rubidium; or that the salts of the other metals would generally be found to undergo, in contact with a soil containing lime, a similar change to that which sulphate of magnesium and other salts are known to undergo. The list of substances that come under the power of soil-absorption is, in fact, a very large one. Chemists have, however, done wisely in concentrating their study upon the commoner salts of those bodies which are known to be an essential part of plant-food, and are consequently always present in fertile soils. An acquaintance with the action of the soil towards these bodies is most important, and they have naturally received the chief share of attention.

Different bases are not equally absorbed by soil. Few experiments have, however, been made that allow of an exact comparison. Way found that a clay, treated respectively with chloride of ammonium and nitrate of

* The absorptive action of soil towards the gases of the atmosphere has been but little investigated, and must be passed over for the present.

† *Journal of the Royal Agricultural Society*, vol. xi., p. 313.

‡ In experimenting with a clay derived from soda-felspar, Way found the filtered liquid to contain sodium salts, in place of the calcium salts usually present.

potassium (the salts being used in the proportion of their chemical equivalents), took up a larger percentage of the ammonium than of the potassium, although, at the same time, a greater quantity of the potassium was absorbed. In experiments by Küllenburg,* in which each salt was also used in its equivalent proportion, the bases were taken up by the soil in the following order, regard being had to the proportions of the equivalent absorbed:—Ammonium, potassium, magnesium, calcium, sodium. The absorptive energy of both soil and clay was thus, from a chemical point of view, greatest for ammonium.

Not only is there this difference with regard to various bases, but experiment has shown that a base is not equally absorbed by soil from its various salts. The hydrate, the phosphate, and carbonate appear to be the salts from which the soil takes up the largest quantity of base; while, from the sulphate, nitrate, and chloride, the soil generally removes a notably smaller quantity.† Of the last three salts, the greatest absorption is usually from the sulphate. Only a few series of experiments have been published in which the behaviour of the same soil towards various salts is fairly compared. It is essential, for such a purpose, that the solutions of the various salts employed should each contain, not the same proportion of salt to water, but the same proportion of *base* to water—that, in fact, each salt should be used in the proportion of its chemical equivalent. It is also necessary that a constant proportion be maintained between the weight of soil and the volume of salt-solution throughout the experiments. The earlier experiments on soil-absorption were not made with this exactness. Küllenburg has recently published an elaborate series of experiments upon one soil, employing each salt in its equivalent proportion, and in five states of dilution. Taking the total absorption in each five experiments as representing the absorptive power of the soil for the particular salt employed, and calling the greatest absorption in each series 100, we have the following as the proportion in which the bases were removed from their various salts:—

Comparative Absorption from Different Salts of the Same Base.

(The greatest absorption reckoned as 100.)

	Ammonium.	Potassium.	Sodium.	Magnesium.	Calcium.
Phosphate	100	100	100	—	—
Carbonate	62	95	85	—	—
Sulphate	56	72	48	100	100
Nitrate ..	48	58	53	84	64
Chloride	45	57	60	81	81

We see that, in every case, the soil retained most base from the solution of the phosphate and carbonate, and that the sulphate stands next highest, except in the case of sodium. Henneberg and Stohmann,‡ experimenting on a garden-soil with salts of ammonium, found the absorption of ammonium from the various salts to be in the following order:—Phosphate, hydrate, sulphate. The absorption from the chloride and nitrate was about equal, and the smallest of any. E. Peters‖ found the following order of absorption with salts of potassium:—Phosphate, hydrate, carbonate, bicarbonate, nitrate, sulphate, chloride. Fraas,§ using lysimeters as the vessels for his experiment, found the absorption of potassium salts to be in the order of carbonate, sulphate, nitrate. The only experiments I know of respecting the absorption of phosphoric acid from its various combinations are those by Küllenberg, forming part of the series already referred to. He employed the phosphates of potassium, sodium, and ammonium, and found the proportion of acid removed by the soil from these salts to be as 100 for the potassium salt, 87 for the sodium, and 68 for the ammonium. The whole of this branch of the subject requires further research.

The quantity of a substance which a soil will take up when shaken with a solution of it, is found to depend very much upon the strength of the solution. The following rule has been thoroughly established by a number of observers:—Soils remove the greatest proportion of base from a salt solution when that solution is weak, but they take up the greatest quantity when the solution is strong. Thus, in one of Küllenberg's experiments, 100 grms. of soil took up 0·2360 grm. of potash from a solution of the sulphate, while from a solution of 1-5th the strength the same weight of soil only absorbed 0·0977 grm.; but in the first case only 21·1 per cent of the total potash was taken up, while in the last the absorption was 43·8 per cent. The first part of this law probably holds good only in those cases where, as in the experiments from which it is deduced, the salt is in excess of the soil. A strong and weak solution poured in each case upon an excess of soil would, we conceive, have their salt equally removed, unless, indeed, the stronger solution was so concentrated that it failed to moisten the bulk of soil necessary for its absorption. It is said, by many investigators, that a soil never removes the whole of a substance from solution. This may, perhaps, be true when taken in its absolute sense. The proportion of the salt removed must, however, greatly, depend on the volume of soil employed. If, as in most experiments, the soil is shaken up with four or five times its bulk of liquid, a notable quantity of the salt will remain unabsorbed; but, if the soil be used in excess, and the liquid filtered through it, as in Way's original experiments, the absorption of ammonia, potash, and phosphoric acid will be found to be all but complete, minute traces only appearing in the filtrate; a fact amply attested by the analysis of drainage waters from cultivated fields.

The bases absorbed by soil are, to some extent, given up again when the soil is treated with water. Voelcker found that a soil which had taken up ammonia from solutions of the hydrate, sulphate, and chloride, gave back again half of the quantity absorbed when washed from four to seven times with four times its weight of water, the water remaining in contact each time for several days. E. Peters found that a soil which had absorbed potash, gave up about 1 part of potash to 30,000 of water, but that the potash was much more soluble in water containing carbonic acid. The information we have on this head is very scanty; more experiments are much needed.

A further point that has been noticed respecting the absorptive action of soils is the displacement of one base by another. We have already seen, in Way's experiments, how the absorption of ammonia or potash from their salts is generally attended by the separation of lime from its combination in the soil. In the same way, a soil saturated with ammonia gives up a part of its ammonia when treated with a potassium salt, and potash to some extent replaces the ammonia in the soil. This action, too, has been but little studied, though practically of great importance. Voelcker has pointed out that the beneficial action, upon some soils, of common salt may be owing to the displacement, by the soda, of some of the more valuable constituents of plant-food which the soil contains.

We have now to consider the various explanations which have been offered of these remarkable phenomena of soil absorption.

In Way's first paper, no attempt is made to establish a theory respecting the absorptive power of soils. He plainly states that he considers the operation a purely chemical one, and hints that the absorptive faculty resides in some constituent of clay. He shows, by experiment, that ignition of a soil or clay greatly diminishes its absorbing power; that treatment with strong acid till all soluble matter is removed fails to extinguish the absorptive power, though more or less diminishing it. In his second paper, Way describes a series of experiments with

* *Jahresbericht der Agrikultur-Chemie*, 1865, p. 15.

† Some soils appear capable of removing about equal quantities of ammonia from solutions of free ammonia and of the three salts just named.

‡ *Jahresbericht der Agrikultur-Chemie*, 1858-9, p. 25.

‖ *Ibid.*, 1860-1, p. 9.

§ *Ibid.*, 1861-2, p. 11.

certain artificially-prepared hydrated double silicates, which satisfied him that it was to the presence of such compounds in soils that their absorptive power was to be attributed. Way took a solution of silicate of sodium, and poured it into a solution of alumina in soda; the precipitate that formed was a double silicate of aluminium and sodium. This compound, if treated with lime-water, or a solution of any calcium salt, gave up soda and absorbed lime. The resulting double silicate of aluminium and calcium, if treated with a salt of potassium, gave up lime and absorbed potash. If the sodium, calcium, or potassium salts were treated with a salt of ammonium, they gave up soda, lime, or potash, and absorbed ammonia. In fact, as far as the experiments went, all the principal features which mark the absorption of bases by soil were displayed in still greater energy by these artificially-prepared silicates. The affinity of the silicate of aluminium for bases appeared to be greatest for ammonia, and least for soda; salts of ammonium would decompose any of the other silicates. The silicates of aluminium and calcium had the power of absorbing ammonia gas from the atmosphere. All the silicates possessed a very considerable degree of insolubility.

The explanation of the absorptive action of soils put forth by Way has not met with unanimous acceptance among agricultural chemists. It would be tedious to narrate the views and conclusions of each experimenter, founded as they are in many cases on very limited data, but we may point out the principal divisions of opinion.

Way's opinion, that the absorption by soil was a result of the chemical combination of the substance absorbed with some constituent of the soil, has been, on the whole, generally shared by subsequent experimenters. Some, as Rautenberg and E. Heyden, have supported Way's theory of silicates in its entirety, and have sought to show that the absorptive power of a soil is in proportion to the amount of silicates (decomposable by the alternate action of hydrochloric acid and carbonate of sodium) which it contains. Others, as Knop and Voelcker, while not denying the absorptive power of silicates, have pointed to the hydrated oxides of iron and aluminium as a further and important source of the absorptive energy of soils. Others, again, have experimented with the organic matter of soils, that assemblage of little known-bodies that usually goes by the name of humus, and have shown that it, too, to some limited extent, possesses absorptive powers.

Besides these opinions, all of which take a chemical view of the question, we have the wholly different view put forth by Liebig, who considers that the absorption of the various substances by soil is not in any way a result of chemical combination, but is merely a consequence of the "physical attraction" of a highly porous body. We are referred to the well-known power of charcoal, of removing certain substances from their solution in water, in consequence of which property it is so largely used as a decolourising agent. The ordinary process of dyeing is quoted as another illustration of the same action; where certain organic colouring matters are removed from solution by the vegetable or animal fibre and remain very permanently united to it. We are told there is, in these cases, no chemical combination between the absorbent and the substance absorbed, that the action is the result of mere physical attraction, and that the absorbent powers of soil are nothing more than a manifestation of the same action towards certain inorganic salts. It will be as well to state the view taken by Liebig in his own words*—

"There can be no doubt that all the component parts of arable soil have a share in these properties, but only when they possess a certain mechanical condition, like wood or animal charcoal; and that this power of absorption depends, as in charcoal, upon a surface attraction, which is termed a physical attraction, because the attracted particles enter into no combination, but retain their chemical properties.

"The term 'physical attraction,' as used here, does not signify a peculiar attractive force, but merely designates the ordinary chemical affinity, which shows differences of degree in its manifestation.

. . . . . .

"From a solution of carbonate of potash or ammonia, or from a solution of phosphate of lime in carbonic acid water, the arable soil will withdraw the potash, ammonia, and phosphoric acid, without any chemical interchange with the constituents of the earth taking place."

We will not at present inquire whether Liebig's view of the subject, or the views of other chemists already quoted, are more in harmony with the facts of the case, but will only just remark that Liebig's description of the attractive power of soil and other absorbents as nothing more than an instance of "ordinary chemical affinity," seems hardly consistent with the other statements he makes regarding this property. Liebig tells us that *all* the component parts of arable soil have a share in this chemical affinity, if only they possess a sufficiently porous texture. Now we can readily understand that an insignificant chemical affinity may be greatly exalted by increasing the surface of the acting body; but that the various constituents of soil, differing as they do so greatly in their chemical nature, should all of them, if they display the necessary amount of surface, exhibit the same chemical affinity for the same substances, is more than a chemist will readily believe. This, however, is what is virtually assumed by Liebig. He tells us, "there is no perceptible connection between the composition of a soil and its power of absorbing potash, ammonia, and phosphric acid." If mechanical texture is everything, and the chemical properties of the material nothing, the phenomena in question must clearly be physical, and not chemical.

(To be continued.)

* "The Natural Laws of Husbandry," pp. 67—69.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor TYNDALL, LL.D., F.R.S. (Lecture I.)

1. IF two pieces of the same metal (pure zinc or pure platinum, for example), be immersed in water, which has been rendered sour by the addition of a little sulphuric acid, the acidulated water attacks neither.

The ordinary zinc of commerce, being rendered impure by the admixture of other metals, is attacked by the acid. It may, however, be enabled to withstand the acid by covering its surface with mercury. The zinc is dissolved by the mercury, detached from its impurities, and presented to the liquid. This process is called *amalgamation*.

2. If two pieces of two different metals (pure zinc or pure platinum, for example), be immersed in acidulated water, no sensible action occurs *as long as the metals do not touch each other;* but the moment they touch, and as long as they continue in contact, the zinc is attacked by the acidulated water and dissolves, while bubbles of gas rise from the surface of the platinum.

3. This gas when collected proves to have the specific gravity of hydrogen; like hydrogen it also burns in the air. The water, in fact, is decomposed by the touching metals; its oxygen unites with the zinc to form oxide of zinc, while its hydrogen escapes from the platinum.

4. If the two metals be only partially plunged into the acidulated water, it does not matter whether contact occurs *within* the liquid or *outside* of it. The effect, in both cases, is the decomposition of the water, the solution of the zinc, and the liberation of the hydrogen gas.

5. When the two partially immersed metals are connected outside the liquid by a long wire (say of copper) the effect is the same as when they touch directly. In both

cases a *circuit* is said to be formed, consisting of the two metals and the liquid. In the case last mentioned the copper wire is said to complete the circuit.

For these experiments a strip of platinum and a strip of amalgamated zinc are employed. The liquid is placed in a glass cell with parallel sides through which is sent a beam of light, and by means of a lens a magnified image of the cell and its two strips is cast upon a screen. The chemical action consequent upon touching the metals, or on completing the circuit with a wire, and its suspension when contact is interrupted, are then very plainly seen.

6. The wire is also said to be the vehicle of an *electric current* which flows round the circuit. It is also called a voltaic current, because the action here described was discovered by the celebrated Italian philosopher, Volta. These terms, however, convey to us, as yet, no meaning. Our sole business during the present lecture is to examine the wire which completes the circuit, and to determine wherein it differs from an ordinary wire.

7. And to enable ourselves to do this effectually, we shall employ an arrangement, or a combination, of zinc and platinum plates and acids, known as a voltaic battery. We shall subsequently analyse this battery, and determine what occurs within it. For the present, as aforesaid, we shall confine ourselves to the examination of the wire which completes the circuit outside the battery.

8. Interrupting the circuit, and immersing the wire in iron filings, it shows no power of attraction over them. Establishing the circuit, on re-immersing the wire in the filings they cluster round it and cling to it. If the wire be raised out of the filings, they form an envelope round it. The moment, however, the circuit is interrupted, the filings fall.

9. If the wire be disconnected from the plates of platinum and zinc, and stretched under and parallel to a suspended bar magnet, no action is observed; but on making the wire, stretched beneath the magnet, form part of a voltaic circuit, the magnet is deflected from the magnetic meridian. This is Œrsted's discovery.

10. To the eye the wire, if tolerably thick, is unchanged by its connection with the zinc and platinum. But if for the thick copper wire a thin platinum wire be substituted it is sensibly heated, and may even be caused to glow brightly. The wire, therefore, must be the vehicle of some power or condition which is competent to produce both magnetic and thermal phenomena.

11. If a naked wire, forming part of a voltaic circuit, be wound round a bar of iron, the power of which the wire was the vehicle is in great part transmitted to the iron, which becomes part of the circuit.

12. But, if the wire be overspun with cotton, or, still better, with silk, this transmission of the power from the wire to the iron bar is prevented. The wire may then be coiled round the bar, while the power is compelled to pass in succession through all the convolutions of the wire. Here the iron bar is not at all in the circuit.

13. But, though not in the circuit, it is powerfully excited by the surrounding wire. Every convolution of the wire evokes a certain amount of *magnetism* in the bar; and, by rendering the convolutions sufficiently numerous, a magnet of enormous strength may be thus generated. This is Arago's discovery.

14. Such a magnet is called an electro-magnet, to distinguish it from ordinary permanent steel magnets. When the circuit is broken, the power of the electro-magnet ceases. It then falls from its highly-excited condition to the condition of ordinary iron.

15. For electro-magnetic purposes, the covered wire is usually coiled round a hollow reel, several layers of coils being sometimes superposed upon each other. In this condition, the reel is called an *electro-magnetic helix*. The iron bar to be magnetised is placed within the helix, forming its *core*. The electro-magnet may be either straight, shaped like a horseshoe, or it may be caused to assume other forms.

16. The smooth bar of iron placed across the ends or poles of a horseshoe-magnet is sometimes caled a *keeper*, sometimes an *armature*, and sometimes a *sub-magnet*.

17. It is not necessary that the convolutions of the helix should be close to the core: a hoop, for example, 1 yard in diameter, round which covered wire is coiled, magnetises an iron bar placed across it at its centre. The magnetised body is here nearly 18 inches from the magnetising-coil. How is the power transmitted from one to the other? is it an action at a distance, or does it require a medium for its propagation? I do not know. The question, at present, profoundly interests investigators.

18. If a covered wire forming part of a voltaic circuit be coiled round an iron bar near one of its ends, there is a propagation of the excitement along the bar towards the distant end. As the coils augment in number, the attractive power of the distant end increases. On undoing the coils, the magnetism gradually falls. The process resembles, more or less, the conduction of heat—the augmentation of the coils answering to the increasing of the temperature, and the undoing of the coils answering to the cooling of the end of the bar.

19. When the end of a cylinder of iron is partially introduced into an electro-magnetic helix, on completing the circuit, a force of suction is exerted upon it, tending to draw it into the helix. Page turned this force to account in the construction of an electro-magnetic engine.

Hollow iron cylinders, which pass freely into the helix, are employed for this experiment, the end only of the hollow cylinder being introduced. When the circuit is completed, the cylinder is suddenly and strongly sucked in.

20. Others have turned to account mechanically the attraction exerted by electro-magnetic cores on bars of iron. The distinguished electro-mechanician, Froment, produced rotatory motion in this way. A series of electro-magnets are so ranged that their poles lay facing each other along the circumference of a circle; and a series of tranverse bars of iron are so connected together as to be able to approach the poles in succession, and rotate as a system. When the circuit is established, these bars are attracted, motion being thus imparted to the system. The bars, on arriving at the poles which attract them, suddenly cease to be attracted, the magnetism being temporarily suspended to allow each bar to pass forward, with the velocity impressed upon it, to the next pair of attracting poles. On reaching these, the magnetism is again temporarily suspended. Thus the bars *are never pulled back*; and in this way a continuous motion of rotation is maintained.

21. This rotatory motion can be applied in various ways; it may, for example, be caused to pump water, to saw wood, or to drive piles.

One of Froment's electro-magnetic engines, and its application to pumping and pile-driving, is employed to illustrate this.

22. Sound is one of the physical effects which accompany sudden magnetisation and sudden demagnetisation. An ear placed close to an iron core hears a clink the moment the circuit is established round it. A clink is also heard when the circuit is broken. This is Page's discovery. Employing a contact-breaker (in a distant room, to abolish its noise), the coil may be magnetised and demagnetised in quick succession; the sounds then produced may be heard by several hundreds at once.

A poker of good soft iron, placed within an electro-magnetic helix, and with its two ends supported on wooden trays, produces a very good effect. The sound may be rendered musical.

23. When an iron bar is magnetised, its volume is unchanged, but its shape is altered; it lengthens in the direction of magnetisation. This is Joule's discovery.

24. Joule employed a system of levers to augment the effect, and a microscope to observe the elongation thus augmented. Our method is this:—The iron bar is magnetised by an electro-magnetic helix which surrounds it. Its elongation is first augmented fiftyfold, by means of a

lever; and this motion is applied to turn the axis of a rotating mirror. From the mirror is reflected a long beam of light, which forms an index without weight. The reflected beam may be caused to print a circle of light upon a white screen, and this circle, when the bar is magnetised, suffers a displacement, due to the elongation of the bar. This displacement may amount to a foot or more.

What is the cause of this elongation? The discussion of this question requires some preliminary knowledge.

25. If a sheet of paper, or a square of glass, be placed over a magnet, iron filings, scattered on the paper or on the glass, arrange themselves in lines, which Faraday calls lines of force. Along these lines, the filings set their longest dimensions, and they also attach themselves end to end. A little bar of iron, or a small magnetic needle, freely suspended, sets itself also along these lines of force.

The formation and modifications of the magnetic curves, or lines of force, are shown in this lecture by means of small magnets held between plates of glass and strongly illuminated. Magnified images of the curves are thrown upon a screen about 40 feet distant. The shifting of the curves by the tapping of the glass is plainly visible.

26. We may regard a bar of iron as made up of particles united by the force of cohesion, but still to some extent distinct. When iron is broken, we see crystalline facets on the surface of fracture. In fact, the bar is composed of minute crystals of irregular shape. These, when the bar is magnetised, try to set their longest dimensions parallel to the direction of magnetisation—that is to say, in the direction of the bar itself. They succeed in this effort to some slight extent, and thus produce the minute and temporary lengthening of the bar. This is the explanation of De la Rive; it is, I think, as true as it is acute.

27. Magnetic oxide of iron may be suspended as a powder in water contained in a cylindrical vessel with flat glass ends. Let the vessel be surrounded by a coil of covered wire. Looking at a candle through the muddy liquid, and making the coil part of a voltaic circuit, the candle brightens at the moment the circuit is made. Breaking the circuit, dimness again supervenes. This is due to an arrangement of the particles of suspended oxide, similar to that of the iron filings. They set their longest dimensions parallel to the beam of light, and thus obstruct its passage less. They also attach themselves end to end, and form lines like the lines of filings. This beautiful experiment is due to Grove.

Projecting a magnified image of the end of the cylindrical cell on a screen, and sending through it the beam of the electric lamp whenever the circuit is established, an illuminated disc, 2 or 3 ft in diameter, flashes out upon the screen.

NOTICES OF BOOKS.

A Manual of Qualitative Analysis. By ROBERT GALLOWAY, Professor of Applied Chemistry in the Royal College of Science for Ireland, &c. Fifth edition; re-written and enlarged; with plate, and other illustrations. London: John Churchill and Sons. 1870.

THAT a work of this kind should reach, in a few years, a fifth edition, is, in itself, positive evidence that such a book is a really useful one to a great number of students. The new edition before us is materially improved, and also greatly enlarged. Among the additions, we find—Bunsen's Flame Reactions, with a plate of figures of the apparatus; the Detection of the Poisonous Metals and Acid Radicals in the Presence of Organic Matter; Additional Tests for the Detection of the Individual Alkaloids, and More Complete Systematic Methods for the Detection of these Bodies. The new notation has been adopted; and the book has been divided into three main parts, treating, respectively, on Inorganic Analysis, Analysis of Organic Substances, and on Operations. There is found, almost at the end, an excellent list of apparatus required for qualitative analysis, and appendices wherein the treatment of silver, platinum, and gold residues is fully treated.

Attfield's Saturation Tables, for Acids and Alkaline Carbonates. Printed and published (under authority) by H. Silverlock, 92, Blackfriars Road, and Earl Street, Doctors Commons. Price 6d.; mounted on card, varnished, and eyeletted, 9d.

THESE tables are reprinted in large type from Dr. Attfield's valuable work on "General, Medical, and Pharmaceutical Chemistry." They are issued in the most convenient form for constant reference, and will be found useful to chemists and pharmaceutists.

CORRESPONDENCE.

GRADUATING DIAPHRAGM.

To the Editor of the Chemical News.

SIR,—In one of Mr. Suffolk's excellent articles on "Microscopical Manipulation" (vol. xx., p. 291), he mentions one form of graduating diaphragm.

Allow me to supplement this with the following extract from the *Journal of the Franklin Institute*, of February last, in which is described a new and very ingenious contrivance by Mr. J. Zentmayer, so well and widely known from his microscopic stands and lenses, and orthoscopic view lens, made with one kind of glass only, and yet without any chromatic error which can be detected by very delicate tests.

"At the last meeting of the Institute, there was exhibited this exceedingly ingenious arrangement, which is shown in the accompanying cuts, which are taken from

FIG. 1.

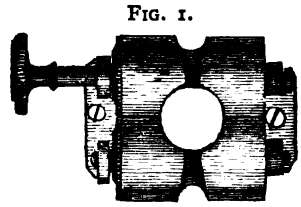
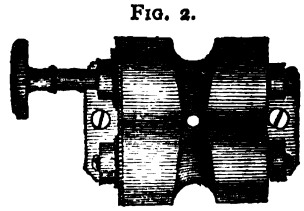


FIG. 2.



photographs; Fig. 1 showing the apparatus with its largest, and Fig. 2 with its smallest opening. To obtain a circular diaphragm which, like the eye, should expand and contract gradually by a continuous change, and yet be made of rigid and unchangeable material, might seem, at first sight, to be an impossibility; but, after all, when the result is accomplished, as in this apparatus, we are surprised as much by the simplicity as by the ingenuity of the means employed.

The wood-cuts almost explain the apparatus of themselves; but we may say, in addition, that it consists of

two cylinders or rollers with parallel axes and surfaces in contact, having similar conical grooves on their surfaces, and fine teeth cut at one end of each, which, gearing together, cause them to rotate in unison.

There is, theoretically, an objection to a diaphragm of this construction, from the fact that its opening will not always be in the same plane—that is, the smallest cross-section of the space between the rollers will not always be equidistant from a plane at right angles to the line of sight and passing through the axes of the rollers. With the larger opening, this smallest section will be nearest to, and with the smaller, further from, such a plane.

In practice, however, this difference is so small as to be entirely unimportant, and may even, in some cases, be turned to advantage."

There are other forms of gradually adjustable stops which have been employed with more or less success, but few involving so many elements of durability and convenience.—I am, &c.,

Henry Morton.

Franklin Institute,
Philadelphia, U.S.

ANALYSTS' FEES.

To the Editor of the Chemical News.

Sir,—Is it not time that some regular scale of fees be recognised by the body of qualified analytical chemists, to which appeal could be made in cases of dispute? In a recent judgment at the County Court, His Honour considered that "two guineas was a fair charge" for a complete analysis of water to be used for brewing purposes; and a chemist, who parades F.C.S. after his name, and on his card states he is *from* the Royal School of Mines, was actually found to give evidence that his charge was a guinea and a half!—I am, &c.,

William Baker,
Associate of the Royal School of Mines.

County Analyst's Office, 46, High Street,
Sheffield, April 28th, 1870.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

Sir,—I notice in the Chemical News (vol. xxi., p. 200) that Mr. D. B. Hewitt, in his contribution to the sulphuric acid controversy, mentions that Mason's ores require much less nitre per 100 parts of sulphur burnt than do other ores. Would he kindly say whether this applies only to "Mason's" ores? or does it take in all Spanish and cupreous ones? The reason for one kind requiring so much less than another would also oblige.—I am, &c.,

O. V.

DOUBLE ARSENIATE OF MAGNESIA AND AMMONIA.

To the Editor of the Chemical News.

Sir,—I read with interest the note on the double arseniate of magnesia and ammonia by Mr. Frederick Field, F.R.S., in the Chemical News (vol. xxi., p. 193). Mr. Field, however, slightly misunderstands the conclusion of mine, to which he draws attention in his paper. By the "excess of water" which is driven off between 100° and 110° I mean the excess above the 1 equivalent, not, as Mr. Field understands, the whole of the remaining water.

Experiments that I have made seem to indicate that this equivalent is retained, even after prolonged heating at a temperature of 120° C. As to drying the precipitates from the various estimations at a temperature of 100° to 110°, I followed precisely the instructions given in Fresenius's "Quantitative Analysis;" drying at the above temperature is there advised, the dry arseniate at the same time being represented as retaining its equivalent of water.—I am, &c.,

E. W. Parnell.

Runcorn, May 3rd, 1870.

MISCELLANEOUS.

Fluids in Crystals.—Spectrum analysis has been applied by Vogelsang and Geissler to the difficult question of determining the chemical nature of the fluid found inclosed, in minute quantity, in the cavities of certain quartz-crystals. Fragments of quartz were placed in a small retort which was connected with an air-pump and exhausted; then, by the application of heat, the quartz decrepitated, and the evolved vapour was examined in a Geissler-tube. The presence of carbonic acid was thus abundantly proved, and this was confirmed by the turbidity which it produced in lime-water.

Death of the Dean (Doyen) of the French Professors.—We learn, from the *Moniteur Belge* of the 30th ult., that Dr. Lordat, Honorary Professor of the University of Montpellier, has just died there, at the advanced age of 98 years. The deceased took the degree of M.D., at the university just named, in 1797, and for a series of years he occupied the post of Doyen de la Faculté de Médecine, and was among the best teachers and the most expert medical practitioners that University has possessed. The deceased resigned from his active duties some ten years ago, retaining the titles simply honorary. Dr. Lordat was a staunch supporter of the doctrine of *vis vitalis*, and adverse to the explanation of the phenomena of life by merely physical or chemical action. He has published a great many excellent medical works, and was (not only at Montpellier, but in the whole of Southern France) a physician whose aid and advice were esteemed of great value. His valuable library, including that of the late *savant*, Barthez, has been bequeathed by him to the Medical Faculty of the University above named.

Working Under High Pressure.—We glean the following particulars from the reports of the works at the Illinois and St. Louis Bridge:—At a depth of 85 feet, it was first noticed in the east air chamber that the flame of a candle would immediately return when blown out by the breath, sometimes after an interval of a few seconds, and that repeated blasts of the breath were required to finally extinguish the light. This phenomenon is not observable at the present depth of the west air chamber (over 71 feet) The flame of the candle is, perhaps, twice as large as in the normal atmosphere, but such large quantities of carbon (particles of lamp-black) and smoke are emitted as to constitute a serious annoyance, requiring several expedients to get rid of it. Two curious accidents from fire have occured in the east chamber, one of which caused serious injury to one of the workmen. This man was engaged in passing out cement from the air-lock into the air chamber, when his coat skirts came in contact with a candle in the lock, and, although his garments were woollen, one leg and arm were badly burned before the flames could be extinguished. In the other case, the under clothing of the man saved him from injury, the external ones about the waist being badly burned, and only extinguished by his fellow workmen throwing him down into a pool of water in the bottom of the chamber. Candles are the only lights permitted within the air chambers, being less liable to cause accidents. About 4 atmospheres are now contained within the east air chamber, the pressure being about 44 lbs. above the normal one. Within the last few days, several of the workmen employed in filling the east chamber with concrete have been severely attacked with paralysis. No death from this cause occurred until after the depth worked in was over 95 feet; three or four have occurred within the past ten days, which were believed to have been superinduced

by the severe air-pressure. At the coroner's inquest held on the last one, two distinguished physicians present attributed the abnormal developments exhibited by *post mortem* examination to diametrically different causes—one to a too sudden change from the normal to the dense atmosphere, and the other to the too rapid transition from the dense to the normal pressure. Neither of these is correct, as the lock-tenders have never been thus affected, while they are alternately under the pressure fifteen to twenty times during a watch of two hours while passing the workmen in and out. It is probable that the duration of time to which the system is subjected to the unnatural pressure is the chief cause of the paralysis induced, as many hundreds, indeed thousands, of visitors have entered, and remained in the chamber from thirty minutes to an hour and a half, without one of them being thus affected. The chief engineer forbade the workmen remaining longer than one hour at a time in it. After thus working for four days, the workmen themselves protested and petitioned against this; and two-hour shifts have been since instituted, in consequence of their expressed desire.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, April 25, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Researches on New Platinic Compounds Derived from the Phosphuretted Bases.—A. Cahours and H. Gal.—This paper contains the record of researches on the results of the reaction of bichloride of platinum upon triethyl-phosphine. The authors observe that compounds are formed the composition and constitution of which are exactly alike, although their properties differ considerably. The memoir is too lengthy to enter into full details on this subject here; we therefore propose to give to our readers a full translation of this paper at a future day.

Utilisation of the Secondary Products obtained by the Manufacture of Chloral on the Large Scale.—Dr. A. W. Hofmann.—The main gist of this paper is that, in Germany, a very large quantity of hydrochloric ether is prepared as a by-product of the preparation of chloral, and the author applies this and other by-products of this manufacture for the preparation of ethyl-ammonias. The author's paper in this number contains a large number of quotations of the results of his labours published in the *Proceedings of the Royal Society*, and elsewhere in this country.

Geological Microzymas of Different Origin.—A. Béchamp.—The author first alludes to the well-known fact, that perfectly pure carbonate of lime—viz., white marble, Iceland spar—has no action whatever upon starch or sugar solutions. He next states that carbonate of lime from different geological formations contains, invariably, living organisms, termed by him microzymas, and that to these microscopically-small beings is due the fact that different kinds of carbonate of lime produce, when in contact with solutions of cane sugar or starch paste, the phenomena of fermentation. The author not only finds these organisms in comparatively recent formations of carbonate of lime, but even in the oolitic limestone and the calcareous tuffa. The author's very lengthy memoir contains the record of his experiments, into the details of which we cannot enter here any further.

Experimental Researches on the Length of the Duration of the Electric Spark.—Drs. Lucas and Cazin.

Electric Currents.—A. Trève.

Latent Heat of Ice, as Deduced from the Experiments of Laplace and Lavoisier.—E. Renou.

Formation of Drops from Liquids.—Dr. Duclaux.—Reserved for full translation.

Thermical Researches on Iodic Acid.—A. Ditte.—An algebraico-physical paper.

Thermical Researches on the Different States of Aggregation of Sulphur.—Dr. Berthelot.—The chief results arrived at by the author are—The transformation of dissolved octahedrical sulphur into the insoluble variety, under the influence of direct sunlight, is accompanied by an evolution of heat equal to 12·8 calorics to the gramme; the transformation of molten ordinary sulphur into insoluble sulphur is also accompanied by an evolution of heat. The transformations alluded to are promoted by the action of direct sunlight.

This number contains a series of papers on subjects, strictly speaking, belong to astronomy, but, among these, not a few bear upon the spectroscopical observations of the sun's protuberances. Although, strictly speaking, only of local interest, we may not neglect to notice a paper on the—

Agricultural Terrain of the Sologne.—Dr. Mazure.—A paper highly praised by M. Boussingault and others as an excellent pattern for the study of the soils under tillage in its different physical, chemical, and cosmical relations.

The Meteor of the 19th of April last.—Dr. Chapelas.—A full account of the results of accurate astronomical observations on this subject, and description of the phenomena accompanying this apparition.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, January, 1870.

This number, just published, contains no papers at all relating to physical sciences.

Revue Universelle des Mines, de la Métallurgie, et des Travaux Publics de Belgique, No. 1, 1870.

This volume contains the following original papers and memoirs relating to chemistry and allied sciences:—

Best Methods of Agglutination of Mineral and other Fuel.—A. Habets.—A very extensive and exhaustive monograph on this important subject, especially for those countries where coal mining is carried on, and where, consequently, coal-dust and small coal abound.

Motion of Permanent Gases through Pipes.—Dr. Grashof.—A mathematico-physical essay.

Ventilation of Mines, and the Application, for that purpose, of Ventilators Worked Centrifugally.—E. Harze.

Annales du Génie Civil, March, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Warming and Ventilation.—C. Tronquoy.—First portion of a valuable paper on this subject, illustrated with a large number of engravings.

Alunite of Mont-Dore.—J. Gonnard.—The mineral alluded to is met with in a remarkable (geologically) district of France, known as le Puy de Dôme. The material is a greyish, or bluish grey, compact, but rarely crystallised, mass, containing, here and there, beautiful crystals of native sulphur interspersed. The seam, or layer, of this mineral, which is now dug up for the purpose of the manufacture of alum, has a thickness of 100 metres, by a width of from 50 to 60. This alunite contains, in 100 parts—Sulphuric acid, 39·1; alumina, 46·5; potassa, 8·5; water, 5·9. The crystalline alunite of Tolfa (Papal States) contains, in 100 parts—Sulphuric acid, 35·50; alumina, 39·65; potassa, 10·02; water, 14·83. The alunite of Mont-Dore yields, on being heated in closed vessels, earthenware or clay retorts, a small quantity of very pure sulphur.

Journal de Pharmacie et de Chimie, April, 1870.

This number contains the following original papers:—

Chemical Equilibrium between Carbon, Hydrogen, and Oxygen.—Dr. Berthelot.—This paper is the amplification of a shorter paper on this same subject, already quoted from the *Comptes Rendus*.

Constant-Acting Galvanic Battery with One Liquid.—M. Fignier.—Illustrated with several woodcuts, indispensable to the proper understanding of this paper.

Detection of Logwood Colour in Wines, by means of Neutral Acetate of Copper.—J. Lapeyrère.—The author states that, while studying some of the properties of the colouring principle of logwood (*bois de Campêche*), he found that the hematine it contains yields a sky-blue colour with salts of copper. In order to apply this test to wines for detecting if they are doctored with logwood, it is only necessary to place strips of good filtering paper, Swedish being preferred, into an aqueous solution of neutral acetate of copper, and, after drying, use one of these slips to test the wine suspected to be adulterated with logwood colour, by dipping the paper into the wine; and, on removing it from that fluid, care should be taken to cause the adhering drop of wine to flow backwards and forwards over the paper, which is next rapidly but carefully dried. If the wine be as it naturally ought to be, the colour exhibited after drying will be grey, or rose-red greyish; but, if logwood is present, the tinge will be distinctly sky-blue.

Sulphuretted Water.—Dr. Gossart.—The author states that a coal-mining company at Meurchin (Pas-de-Calais), while sinking a

shaft, met, at 250 metres' depth, with water of a temperature of from 43° to 50°, and giving off a most intense foul smell. This water, moreover, came up in such prodigious quantity as to impede the progress of the works for a time. The water is perfectly clear; sp. gr., 1·0021; odour, strongly sulphurous; deposits sulphur on standing. Composition of this water, calculated for 1 litre:—*Gaseous matters*—Sulphuretted hydrogen, 17·48 c.c.; carbonic acid, 6 c.c.; nitrogen, 23·44 c.c.; sulphide of calcium (and the following in grms.), 0·011; sulphate of lime, 0·624; sulphate of potassa, 0·081; sulphate of soda, 1·258; chloride of magnesium, 0·275; chloride of sodium, 1·105; silica, 0·028; fluorine, a trace. *Bituminous matter*, 0·013; total solids to the litre, 3·395 grms.

Moniteur Scientifique, No. 320, April 15, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

The Increasing Expense of Living (le Renchérissement de la Vie).—G. Ville.—Under this title, is published here, *in extenso*, a most interesting public lecture, given at the Sorbonne, wherein the author treats, in reality, on scientific agriculture and the application of manures, as well as of improved cultivation processes, so as thereby to render, not only the crops better in quality, but also to increase the quantity of the produce. This interesting paper contains a large amount of very-generally useful information, but its great length, and the fact also, that, the lecture largely bears on political and domestic economy, prevents us entering into further details.

Composition of some Metallic Benzoates.—F. Sestini.—The author describes ten inorganic salts of benzoic acid, among which the following are most remarkable:—Benzoate of magnesia—

$$2(C_7H_5O_2),Mg+3H_2O,$$

prepared by direct combination of the acid with the base, and evaporated over sulphuric acid; this salt crystallises in oblique prisms, but, when evaporated by heat, it forms a white mass, exhibiting lamellar structure; 1 part of this salt requires 22 parts of water at 35° for solution, which is acid to test-paper. Benzoate of alumina—

$$\left.\begin{matrix}(C_7H_5O_2)_3\\(HO)_3\end{matrix}\right\}\overset{VI}{Al_2}+H_2O,$$

obtained by double decomposition; very soluble in water; solution acid to test-paper; but a basic salt. Benzoate of zinc, $(C_7H_5O_2)Zn$, crystallises either in prisms or in lamellar shape; this salt is more soluble in cold than in hot water; solution is acid to test-paper, and is precipitated by alcohol. Benzoate of cobalt is a beautifully peach-blossom coloured substance. Benzoate of copper is a salt very difficultly soluble in cold water; crystallises, from its boiling-hot solution, in rhomboidal shape, exhibiting a bright blue colour.

Chloride and Iodide of Propionyl.—F. Sestini.—Chiefly a tabulated series of formulæ, and the boiling-points of some twenty different compounds.

Researches on Octylic Compounds.—P. de Clermont.—This very lengthy paper is divided into the following sections:—Hydrate of octylen, $C_8H_{18}O$; chlorhydrate of octylen; bromhydrate of octylen; iodhydrate of octylen; acetate of octylen; octylic glycol, $C_8H_{16}(OH)_2$; diacetate of octylen; chlorhydrine of octyl-glycol; octylenic aceto-chlorhydrine; oxide of octylen. All these bodies are described, with their mode of preparation and properties, at great length.

Mechanical Physiology.—M. Marey.—Under this title, the author describes, at great length, and illustrates with engravings, a very interesting series of experiments on the flight of birds and insects.

On the Saccharate of Hydrocarbonate which Purifies and Saccharises, as alleged by MM. Boivin and Loiseau.—Prof. Dubrunfaut.—In the first place, we are bound to reproduce the French title in full, in order to justify the translation—"Sur le Sucrate d'Hydrocarbonate Dépurant et Sucratant de M.M.," &c. The author criticises very sharply, in this, as yet, preliminary paper, a subject of some importance; but the main point appears to be that the purifying and sucrifying hydrocarbonate does not exist. The author promises an exhaustive paper on this subject.

Les Mondes, April 21, 1870.

Oxyhydrogen Illumination for Public and Private Use.—Rev. F. Moigno.—The author gives, in this paper, an account of the works proposed to be executed by a company in Paris, on an, as yet, limited scale, with the view to test thoroughly the value of the application of oxygen to replace atmospheric air as supporter of the combustion of gas.

Discovery of the Most Ancient Monument of Paris.—Without entering into details which our readers may have seen from the daily papers, concerning the discovery recently made, at Paris, of a very well-preserved amphitheatre of Ancient Lutetia, we only desire to rectify an error some of our daily contemporaries have made on this topic, by stating that the building alluded to is of later date than the Thermæ of Julian, in the Cité of Paris. The fact is that the Amphitheatre is at least two centuries older than the Thermæ.

Metallic Areometers.—M. Leroy.—Metallic areometers are not, as we all know, very common, and would not certainly suit for such purposes as, for instance, taking specific gravities of acids and alkaline fluids; but it is not generally known that, as here reported, the almost exclusive use of glass areometers for taking the specific gravity of neutral liquids, alcohol, saccharine fluids, &c., is, in reality, due (at least, for France), to a contract entered into by the late Gay-Lussac and M. Collardeau, the maker of glass areometers; Gay-Lussac undertaking, for a consideration, to denounce the use, and bring into disrepute, the metallic areometers, which in this paper are highly eulogised and recommended.

Inexplodable Steam Multiplicator.—M. Petit-Pierre.—The author describes, and illustrates by a woodcut, a very useful contrivance for obtaining dry steam (superheated) accompanied with a saving of fuel. Those of our readers who might desire to have full particulars on this excellent subject, should write to the author, 41, Rue Dulong à Batignolles, near Paris; or to M. Bonnaterre, 11, Rue Gaillon, Paris.

Cosmos, April 23, 1870.

Death of Dr. Unger.—This celebrated botanist was found dead in his bed at Grätz (Austria). According to some accounts, the deceased was killed by burglars, by means of strangulation; but, curiously enough, all valuables in his bed-room were untouched. The committee of the medical faculty of Vienna, which was called in by the police to explain, if possible, the cause of the doctor's death, unanimously state that his death was due to natural causes.

Artificial Production of Ice in India.—Dr. Janssen relates that, in many parts of the Indian Continent, the natives dig shallow pits in such localities which are quite freely open to the sky and distant from trees. The pits are lined with straw, and upon the straw are placed dishes (made of a very porous earthenware) filled with water. During the calm and clear nights prevailing during the period from November to the end of February, the water placed in the dishes freezes, yielding a solid cake of ice, while the temperature of the air is +10°. Dr. Janssen has investigated this curious subject experimentally, and has found that the freezing is principally due to the radiation during the night; but the evaporation of the water, aided by the porosity of the earthenware employed, is not to be overlooked, at the same time.

Studies on Grapes; the Juice they contain, and Vinification.—Dr. le Canu.—This rather lengthy paper contains the record of some very important facts relating to the manufacture of wine from grapes.

Machine for Peeling Potatoes.—The Rev. Liévin Bouteca.—The author, Director of the Convent of St. Joseph-de-Nôtre-Dame-de-la-Trappe, at Forges (Hainaut, Belgium), has contrived a machine, by the aid of which one man can peel, without very hard work, from 250 to 450 kilos. of potatoes in an hour's time. After the tubers have been first roughly washed, they are placed in a cylinder, pierced with holes in such a manner as to form a rasp; the bottom of this cylinder is made movable, and also pierced with holes as just stated. Motion is imparted to the bottom of the cylinder by suitable means; and, by this means, the potatoes, by the friction against each other and the rasps, are rapidly peeled, while a jet of water is at the same time applied to wash the peelings down.

Revue Hebdomadaire de Chimie, April 14, 1870.

Preparation of the Extracts from Dye-Woods.—C. Mène.—This paper, too lengthy for any useful abstraction, describes the important improvements made in this branch of industry in France.

Chain-Pump for Work in Thickish Liquids, such as Molasses, Treacle, Tar.—MM. Tesse du Rivaux.—This description is illustrated with a woodcut. The makers of this very useful contrivance reside at Cuernes (Pas-de-Calais, France).

Revivification of the Oxides of Iron Employed in Gas Purifiers by means of Steam.—C. Mène.—From the author's description, it appears that, at the Vaise station of the Lyon gas-works, the following process is applied for regenerating the oxide of iron:—The oxide of iron, saturated with sulphur as it is taken from the purifiers, is placed in a tank made of iron, which, after having been filled, is hermetically closed. A pipe from a steam-boiler admits steam in the middle or bottom of the tank; while at the top thereof another pipe leads into the chimney-stalk of the boiler-furnace, carrying off the sulphuretted hydrogen resulting from the action of the steam (low pressure) upon the sulphide of iron. Actual decomposition of water takes place in this process, its hydrogen combining with the sulphur, and its oxygen reproducing the peroxide of iron. The great advantage of this process is the very considerable saving of time and the space required for exposing the peroxide to the action of the air; a slow process.

Titration of Chlorine and Eaux-de-Javelle Liquors.—A. Bastuert.—After some preliminary remarks upon the extensive application of chlorine preparations for bleaching vegetable fibres, the author describes, in the following manner, the modifications he has brought on to the Gay-Lussac method of chlorine estimation. The instruments used are:—A burette, graduated, not into cubic centimetres, but into divisions corresponding to the degree (what degree is not stated, but it may be according to Baumé's areometer) of the liquid to be operated upon; a measure-glass, called a saturation vessel; a suitable measure for taking the required quantity of test-liquid; a bottle of test-liquor (blue liquid, indigo solution). In order to test the bleaching liquor, the measure-glass is filled with blue liquid. After this has been done, that liquid is poured over into the saturation vessel; and, next, the burette is filled up to the mark with the chlorine solution, which is then poured cautiously into the blue liquid until the colour of the latter disappears. By this means, the whole operation is reduced to two measurements, which may be executed by workmen. We regret that the author of this paper has not more fully and clearly explained the apparatus, as well as the operations intended to be performed. The paper is not at all clear.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, February, 1870.

This number contains the following original papers and memoirs:—

Chemical Constituents of the Asparagus Berries.—H. Reinsch.—Our readers are all acquainted with the vegetable known as asparagus; they also know that, when this plant comes to full development towards the latter end of the summer, it produces berries of the size of medium green peas, of dark red colour, and a waxy appearance. The author has instituted some experiments, and investigated the nature of these berries, which enclose four black-coloured, somewhat angular-shaped, internally greenish seeds, made up of a horny material, like raw coffee, but far more tough than the latter, because, after drying, the asparagus seeds cannot be pulverised in a mortar. The author has collected a sufficient quantity of the berries to try whether the seeds might be used as a substitute for coffee. For this purpose, the berries are bruised, and left to ferment for some days. The seeds are separated from the pulpy mass by means of a sieve; next washed with water; dried and roasted in the same way as coffee. The author made a mixture of equal parts of coffee and asparagus seeds, which, after roasting, was not, when infused with boiling-water, in the least distinguishable from excellent coffee. The berries contain a large amount of glucose (grape sugar), and may, consequently, be used for the production of spirits, after fermentation. Of far more importance, however, may be a substance which the author has discovered in the berries—viz., the pigment contained therein, and named spargancine—a yellowish red colouring matter, soluble in alcohol and ether, and yielding, with salts of lead and alumina, yellow-coloured pigments. The author's researches on this subject are not complete, owing to want of sufficient raw material. As regards the horny seeds they contain oil, grape sugar, a peculiarly bitter principle, spargine, some resin, and a colouring matter. It appears that the crop of asparagus berries (at least, in the neighbourhood of Nürnberg, Bavaria, where the author resides) is very large; a single plant yielded more than ½ lb. of berries.

Estimation of Organic Matter in Spring Water.—Dr. H. Trommsdorff.—This very lengthy essay treats chiefly on the best methods of applying permanganate of potassa, preferably in alkaline solution, to estimate the quantity of organic matter present in water.

Solanine in Potatoes.—P. Vieth.—The author states that a quantity of potatoes, originally of very good quality, and kept during the past winter in a cellar, after having been cooked, were found to be uneatable, in consequence of causing a very bitter taste and burning sensation in the throat. On investigation, these tubers proved to be (externally, at least) quite healthy; they had been excluded from light, and kept from a too high temperature; exhibited no symptoms of sprouting. On being cut through, it was found that, internally, they had become, in part, greenish coloured. The author removed this greenish coloured layer from several of the tubers, dried the substance, powdered it, and treated it, first, for some days, with dilute sulphuric acid. This liquor was first boiled, next precipitated with ammonia; the ensuing precipitate was washed with ammoniacal water, until it ran off colourless; the precipitate was dried and exhausted with boiling alcohol. On evaporating this solution, a yellow-coloured horny substance remained, exhibiting a distinctly crystalline appearance when seen under the microscope. When moistened with sulphuric acid, this substance became, first, orange-coloured, next violet, and at last blue, reactions sufficiently indicating the presence of solanine. Our readers are aware that the potato, *Solanum tuberosum*, in the green stalks, leaves, and seeds, always contains solanine to some extent.

Journal für Prahtische Chemie (double number), Nos. 2 and 3, 1870.

These numbers contain the following original essays and papers:—

Isomorphism of Variously-Composed Bodies.—A. Kenngott.—This paper is so full of formulæ, relating to the atomistic constitution of native minerals (chiefly silicates), that it is not possible to give any abstract of the contents.

Contribution to our Knowledge of Epichlorhydrine.—Dr. F. O. Parschke.—This lengthy essay is divided into the following chapters:—On the identity of dichlorhydrine from glycerine and from epichlorhydrine; on the action of neutral sulphate of potassa upon epichlorhydrine; disulpho-glycerinate of potassa; disulpho-glycerinate of baryta; disulpho-glycerinate of lead; anhydrous disulpho-glycerinate of baryta; disulpho-glycerinate of silver; formation of disulpho-glycerinic acid from chlormethyl-oisethionate of soda and neutral sulphite of soda; action of cyanide of potassium on epichlorhydrine. The author summarises the results of his researches as follows:—(1) The dichlorhydrines from glycerine and epichlorhydrine are identical; (2) by the action of neutral sulphite of potassa upon epichlorhydrine, there is not formed the acid, $C_3H_6O.SO_3OH$, but, instead thereof, disulpho-glycerinic acid is obtained; (3) chlormethyl-oisethionate of soda and neutral sulphite of soda also yield disulpho-glycerinic acid; (4) cyanide of potassium and epichlorhydrine yield, by double decomposition, epicyanhydrine, which, in its turn, may be converted into epihydrine-carbonic acid.

Some New Compounds of Decomposition of Diabenzoic Acid.—P. Griess.

Sulpho-Cyanogen Compounds.—Dr. L. Glutz.—This essay is divided into the following sections:—Behaviour of sulphocyanide of ethyl with concentrated hydriodic acid; derivatives of sulphocyanide of ethyl; rhodan-ethyl-sulphin-chloride; nitrate of rhodan-ethyl-sulphin-oxide, $(C_2H_5SCN)SH_2ONO_3+\frac{1}{2}H_2O$; rhodan-ethyl-sulphin-rhodanide, $(C_2H_5SCN)SH_2SCN$; free rhodan-ethyl-sulphin-oxyhydrate, $(C_2H_5SCN)SH_2OH$.

Composition of Chabacite.—A. Kengott.—This lengthy paper contains, first, a review of the various results of analysis of the mineral called chabacite, as obtained by different authors, and next, a lengthy discussion as to the proper formula to be assigned to this mineral, which is, to some extent, a kind of *bête noire* of mineralogical chemists; because, although it has been analysed by the most competent hands, and the mineral is crystalline, there are great discrepancies in the results. Chabacite contains, in 100 parts, according to some analysts:—Silica, 51·46; alumina, 17·65; lime, 8·91; soda, 1·09; potassa, 0·17; water, 19·66; peroxide of iron, 0·85.

Chemical Constitution of Uric Acid and its Derivatives.—H. Kolbe.

New Derivatives of Acetone.—Dr. Glutz.—As yet only a preliminary notice.

Phenyl Ether.—W. Hoffmeister.—When sulphate of diazobenzol is mixed with excess of phenol, nitrogen is evolved, even at the ordinary temperature of the air, while there is obtained, at the same time, a thick oily fluid, exhibiting an agreeable aromatic smell. When this liquid is treated, first, with excess of caustic soda, and next rectified by distillation with steam, an oil is obtained boiling at from 250° to 255°, which has the same composition as phenyl-ether, and becomes solid on cooling, fusing again at 28°.

Preparation of Acetones by the Aid of Mercuro-Diphenyl.—R. Otto.—Only a preliminary notice.

NOTES AND QUERIES.

Gas Furnace.—Will some of your readers, from experience, inform me which is the best gas furnace for combustions? I believe there is one which is an improvement upon Hofmann's.—B. C. J.

Water Analysis.—Can any of your accomplished correspondents give me a simple practical method of analysing water. Dr. Moffat mentions, in his advertisement in the CHEMICAL NEWS, that he has enquired into the matter; where is his method to be found?—H. O.

Pasting Labels on Sheet-Iron.—What kind of gum or paste is used for sticking printed labels on Birmingham and Sheffield wares? Labels are frequently attached to the unpolished portions of hatchets, scythes, and other edge tools. Such adhesive material would suit my purposes.—T. M.

Crushing and Making Sugar.—A Queensland colonist (a reader of the CHEMICAL NEWS), living in the sugar-growing district, wishes information on the machinery requisite for crushing and making sugar grown on his own farm and on the small holdings around, which are from 8 to 10 acres each. Economy and simplicity are special requisites.—J. C., April 27th, 1870.

MEETINGS FOR THE WEEK.

MONDAY, 9th.—London Institution, 4.
—— Geographical, 8.30.
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 10th.—Institution of Civil Engineers, 8.
—— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."
—— Photographic, 8.
—— Ethnological, 8.
WEDNESDAY, 11th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
THURSDAY, 12th.—London Institution, 7.30.
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Zoological, 8.30.
—— Royal Institution, 3. Prof. Tyndall, "On Electricity."
FRIDAY, 13th.—Quekett Microscopical Club, 8.
—— Astronomical, 8.
—— Royal Institution, 8. Rev. Canon Mosely, "Descent of Glaciers."
SATURDAY, 14th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."
—— Quekett Microscopical Club. Excursion to Carshalton. To Meet at London Bridge Station (South London Line) at 2 o'clock.

TO CORRESPONDENTS.

Chemicus.—Any prism will do, but it should be mounted as a spectroscope.

W. F. K. Stock.—Consult the Blue Book, reviewed in Nos. 542 and 543 of our journal. You can obtain a copy at the Queen's printers, Messrs. Spottiswoode and Co.

A Student.—(1) Apply at the South Kensington Museum for information respecting Government Examinations; but, we are sorry to say, there is no examination for analytical chemists. (2) The Editor has a book in the press.

T. Walsh, M.D.—Several of Faraday's lectures at the Royal Institution were taken down in shorthand, and printed *verbatim* in the pages of the CHEMICAL NEWS; but these are in the early numbers, some of which are out of print, and can only be occasionally got by purchasing a complete set. A second-hand set can be heard of by applying at our office.

THE CHEMICAL NEWS.

VOL. XXI. No. 546.

THE ESTIMATION OF CHLORINE IN NATURAL WATERS.

By THOMAS P. BLUNT, B.A. (Oxon.), F.C.S.

IT may not be generally known that the chlorine in natural waters may be estimated with great readiness and very considerable accuracy by applying to the original water a slight modification of the ordinary volumetric process. The method adopted is as follows:—

A volumetric solution of nitrate of silver is prepared, of the usual strength, by dissolving 170 parts of pure, dry crystals of nitrate of silver in 10,000 parts of distilled water, the strength of the solution being verified in the usual way, by titration with a weighed quantity of chloride of sodium, the final reaction being marked by the use of neutral chromate of potassium.

This standard solution is delivered from a 50-grain graduated pipette, made of narrow glass-tubing, and drawn to a fine point, so that perfect control may be maintained over the flow of the liquid by increasing or relaxing the pressure of the finger. The experiment is made upon 1000 measured grains of the water, to which have been added 3 or 4 drops of a saturated solution of neutral chromate of potassium. The completion of the reaction is marked with great sharpness, by the change from clear yellow to a reddish tinge; and the results are very satisfactory, as the two estimations appended will show. In both of them the chlorine was first determined volumetrically, by the method given above, and subsequently a gravimetrical estimation was conducted upon one imperial pint, which was evaporated to a small bulk, slightly acidified with nitric acid, and precipitated with nitrate of silver. No. 1 was a very pure spring-water, obtained from a remote part of the Welsh hills. No. 2 was procured from a town well, proved by a previous analysis to be contaminated with animal matters.

	Volumetrical estimation of chlorine per gallon.	Gravimetrical estimation of chlorine per gallon.
No. 1	0·994	0·8904
No. 2	7·455	7·4160

The process here given may prove of some interest, on account of the connection which has been lately traced between the quantity of chlorine in a water and its liability to sewage-contamination—a point strongly brought out by the "Report of the Commissioners for the Prevention of the Pollution of Rivers," quoted in a recent number of the CHEMICAL NEWS.

ON THE LAWS WHICH REGULATE THE DIVISION OF A BODY BETWEEN TWO SOLVENTS.

By MM. BERTHELOT and JUNGFLEISCH.

IT is frequently necessary to extract a body which has been dissolved in a liquid, by stirring into the latter another which does not combine with it, and whose action is, therefore, purely physical. Such means are frequently used for extraction, and even estimation, of bodies held in suspension in other liquids.

The action of the following bodies has been studied:—Iodine and bromine, in the presence of water and of sulphide of carbon; succinic, malic, tartaric, oxalic, acetic, benzoic, sulphuric, and chlorhydric acids, in the presence of water and of ether.

All bodies capable of exercising chemical reaction were carefully excluded from our experiments; and the usual mode of operation was as follows:—The body under treatment was dissolved in one liquid, a certain volume of another was then added; and the whole received a vigorous and prolonged stirring, the vessels being kept at one temperature by means of a water-bath. The body in solution was estimated from time to time, until fixed results were obtained, which sometimes required one or two hours, and the amount was then estimated in each of the superincumbent liquids.

The Co-Efficient of Division.—A body simultaneously brought in contact with two solvents, in each of which it could be separately dissolved, never dissolves wholly in one to the exclusion of the other. Whatever may be the solubility of the body in question in one of these solvents, and whatever may be the excess of that solvent, the body is always divided between the two solvents.

Quantities dissolved by the same volume of two liquids remain in one constant relation between them. We will call this relation the co-efficient of division; it is independent of the relative volumes of the two solvents, but dependent on concentration and temperature. The following examples, cited from our numerous experiments, will be sufficient to establish this law.

SUCCINIC ACID, WATER, AND ETHER, AT 15°.

	Final volume of the liquid.		Volume of baryta-water saturating 10 c.c. of the liquid.		Co-efficient of division.
	Aqueous.	Ethereal.	Aqueous.	Ethereal.	
	c.c.	c.c.			
Concentrated liquids.	70	30·0	42·4*	7·1	6·0
	49	49·0	43·8	7·4	6·0
	28	55·5	47·4	7·9	6·0
More diluted liquids.	30	70·0	18·8	3·4	5·5
	17	17·0	16·2†	3·0	5·4

The co-efficient of division of a body between two solvents is analogous to the co-efficient of division of a gas between a liquid, which will dissolve it, and an empty superposing space; but, in the latter case, it is the tension of gas in the unit of volume of the empty space, which determines the quantity dissolved in the entire volume of liquid. In the case of a body divided between two solvents, it is the final quantity dissolved in the unit of volume of one of these liquids, which determines the quantity dissolved in the unit of the other.

Influence of Temperature.—The co-efficient of division changes with the temperature, but very slowly.

	Weight of succinic acid contained in 10 c.c. of the liquid.		Co-efficient of division.
At 15°	0·376	0·060	6·2
,, 0°	0·376	0·078	4·9
,, 15°	0·106	0·019	5·5
,, 0°	0·098	0·019	5·0

Influence of Concentration.—The co efficient of division varies with the final concentration of the solvents, but not in proportion to the weight dissolved; its progress is slower.

Experiments with malic, tartaric, and acetic acids demonstrate that the co-efficient varies more rapidly with the concentration when very soluble bodies are under treatment, than with those which are less so. This difference is explicable because concentrated solutions of tartaric or acetic acid dissolve ether in proportions differing from those effected by diluted solutions.

Sulphuric and chlorhydric acids give rise to a remarkable analogy; ether will dissolve them only when they are

* Equivalent to 0·358 gr. of succinic acid.
† Equivalent to 0·122 gr. of succinic acid.

concentrated. The proportion of acid obtained from their aqueous solutions, which are slightly diluted, is almost inappreciable.—*Comptes Rendus.*

ANALYSIS OF METEORITES.*

By A. R. LEEDS.

DOUBTS having been expressed as to the meteoric origin of a mass of iron, weighing about 300 lbs., which was found upon the Collina di Brianza in Lombardy, an analysis has been made by Dr. Haushofer.† The doubt probably arose from a remark made in the original description, by Chladni, to the effect that Stromeyer had found CO_2 in the mineral. Dr. Haushofer shows that the milkiness which is given when a portion of the mineral, in the form of filings, is burnt in oxygen, and the gas passed through lime-water, is so excessively small that the amount of carbonic anhydride contained in the mineral must be disregarded. The analysis gives:—Fe, 91·1; Ni, 7·7; P, 0·3; Co, 0·2; CO_2, trace. The sp. gr. is 7·596. The Widmannstädtschen figures are brought out strongly on etching the cut faces.

An analysis of the oxidised remains of a meteorite from Cranbourne, in Australia, by the same chemist, gives:—Insoluble silicates, 4·1; SiO_2, 2·3; Al_2O_3, 1·5; Ca, 1·8; PO_5, 1·4; Fe_2O_3, 71·1; NiO, 3·1; H_2O, 13·7=99·0.

The external appearance of the analysed portions is very similar to that of brown clay ironstone or bog-ore: its meteoric origin is shown, however, by the presence of nickel. The hardness is about that of feldspar; sp. gr., 3·74.

An examination of the minerals resembling vanquelinite, in the Royal Museum at Stockholm, has revealed to A. E. Nordenskjöld the existence of a new mineral, a double salt of chromic and phosphoric acids, for which he proposes the name Laxmannite.‡ Two analyses give:—

	I.	II.
Plumbic oxide.. ..	61·26 ..	61·06
Cupric ,, ...	12·43 ..	10·85
Ferric ,, ...	1·09 ..	1·28
Chromic acid	15·26 ..	16·76
Phosphoric acid ..	8·05 ..	8·57
Water	1·31 ..	0·90
	99·40	98·42

and agree with formula—

$$(\tfrac{3}{4}CuO,\tfrac{1}{4}HO)_3PO_5+3(PbO,CuO)_2CrO_3.$$

The laxmannite forms crystalline crusts some lines in thickness, or crystalline masses filled with drusy cavities, whose walls are covered with dark green, glistening crystals. The cleavage is partly crystalline, partly massive and earthy; the colour dark green to pistachio and greyish green. The crystals are monoclinic prisms.—*Journal of the Franklin Institute.*

METALLIC HYDROGEN.

AT a recent meeting of the Lyceum of Natural History, in New York, a paper was read by Dr. Loew, Assistant in the College of New York, "On the Preparation of Hydrogen Amalgam."

The researches of Graham went to show that hydrogen could be alloyed with palladium, and that it was also contained in meteoric iron. He condensed the hydrogen in the palladium, and came nearer proving its metallic character than any other person had done. Schoenbein in his search for ozone, found a method for making the peroxide of hydrogen, which brought him to the very threshold of discovering hydrogenium. Schoenbein's experiment was this—An amalgam of zinc and mercury is violently agitated in water; the water is then filtered, and, on being examined with iodide of starch and protosulphate of iron, will be found to contain peroxide of hydrogen or oxygenated water. Dr. Loew has carried the investigation further, and has, instead of oxidising the hydrogen, succeeded in combining it with the mercury. He takes an amalgam composed of not more than 3 or 4 per cent of zinc, and shakes it with a solution of bichloride of platinum; the liquid becomes black, and a dark powder settles to the bottom. The contents of the flask are then thrown into water, and hydrochloric acid added to dissolve the excess of zinc. The amalgam of hydrogen and mercury at once forms in a brilliant voluminous mass, resembling in every way the well-known ammonium amalgam. It is soft and spongy, and rapidly decomposes, but without any smell of ammonia. The hydrogen escapes, and soon nothing but pure mercury is left in the dish. The experiment appears to show conclusively that an amalgam of hydrogen and mercury can be formed, and that hydrogen is really a metal. It would also throw some doubt upon the existence of the amalgam of ammonium and mercury, and offer an explanation of that compound on the basis of its being the same amalgam of hydrogen and mercury that is prepared in the way now pointed out by Dr. Loew. The smell of escaping ammonia must be traced to some other source than the existence of that radical in combination with mercury.—*Abstract from the Scientific American.*

NICKEL LINNÆITE.*

By A. R. ROESSLER,
Geologist, General Land Office, Washington.

THE valuable metal, nickel, now employed extensively in preparing various alloys resembling silver, for table use, and in making the coins of the United States and other countries, has been but seldom found in this country. In small but not paying quantities, there are several localities of it; and the only one which promises to yield it in abundance is the deposit at Mine la Motte, Missouri, so celebrated already for its copper, lead, iron, and other ores. A specimen of nickel-linnæite or siegenite has been received at the Geological and Mineralogical Cabinet of the General Land Office, yielding over 30 per cent of nickel. Nickel was discovered in 1751, by Cronstedt, in Sweden. It is a metal of a colour not much differing from that of silver; it is magnetic, soft, and malleable; may be forged, rolled, bored, drawn into wire, &c.; it is more tenacious than iron, and less subject to oxidation than silver. In the year 1824 (the statement may yet be found in Thenard's *Traite de Chemie*), it was stated that the metal, nickel, could not be put to any use. However, it was long before this that nickel was employed by the Chinese for the preparation of an alloy termed by them "Packfong;" and, although, in 1776, Englestroem had analysed this composition, no practical application of this metal was made for some time.

The separation of nickel from its ores is exceedingly difficult and complicated. The crude material is the cobalt speiss and the matt obtained in lead and copper smelting works. In order to free this material from arsenic and sulphur, it is first finely pulverised and roasted with pulverised coal. The residue is dissolved in muriatic acid, and the solution diluted with much water in order to separate the bismuth. If the liquid is now mixed with hypochlorite of lime, the iron is oxidised to a peroxide,

* Communicated by Professor Morton.
† *Journ. für Prakt. Chem.*, 1869, p. 328.
‡ *Ann. de Phys. und Chem.*, 136, 299.

* Communicated by Professor Morton.

when it may be precipitated with the arsenic acid existing in the liquid. If the liquid is to be freed from copper, a current of hydrogen is conveyed through the same, and, having separated the precipitate produced, the cobalt is thrown down by hypochlorite of lime. Now the nickel may be separated with milk of lime. In subjecting the precipitate, with carbon, to a red heat, the metal may be obtained in its pure state. The manufacture of "Packfong" in Europe is not of a very old date. This term is synonymous with argentum, German-silver, British-plate, Its composition varies considerably, as may be seen from the following table:—

	I.	II.	III.	IV.	V.	VI.
Copper..	88·00	65·0	43·8	40·4	55·0	50·0
Nickel ..	8·75	16·8	15·6	31·6	20·0	25·0
Zinc ..	—	13·0	40·6	25·4	25·0	25·0
Iron ..	1·75	3·4	—	2·6	—	—
	98·50	98·2	100·0	100·0	100·0	100·0

It may be seen from this that an alloy may be made with less than 10 per cent of nickel; but the wearing-quality of the metal is decidedly injured by too great a reduction in the quality of nickel.

I will remark that No. 1 is the so-called "white copper," made in Suhl, Germany, a century ago, with copper ores containing nickel, and analysed by Brandes. No. 2 is an alloy, made at Paris, which is capable of receiving a fine polish or gilding. Nos. 3 and 4 are Chinese packfong. No. 5 is an alloy as used for knife-handles. No. 6 is adapted for forks. The nickel coins of Switzerland, which have been in use in that country since 1850, consist of an alloy of nickel, copper, zinc, and silver. The proportion of nickel and zinc in the 20, 10, and 5 centimes-pieces is 1·25. While the amount of copper increases with the decreasing value of the coin, the quantity of silver, on the other hand, decreases with the smaller value. The United States' coins now in general circulation contain 88 per cent of copper and 12 per cent of nickel.—*Journal of the Franklin Institute.*

CONTRIBUTIONS TO THE CHEMISTRY OF COPPER.*

By T. STERRY HUNT, LL.D., F.R.S.

1. THE resemblances between silver and copper, in its cupreous form, have already attracted the attention of chemists. The ordinary chloride of silver (argentic chloride) and the dichloride of copper (cupreous chloride) have many properties in common. Both of these chlorides are white, readily fusible, and blackened by exposure to light. Both of them are insoluble in water, but dissolve in ammonia and in aqueous solutions of other chlorides, in which, however, the cupreous is far more soluble than the argentic chloride. A saturated solution of chloride of sodium holds, at 90° C., 16·9 per cent of cupreous chloride; at 40° C., 11·7 per cent; and, at 11° C., 8·9 per cent. A solution containing 15 per cent of chloride of sodium retains, at 90° C., 10·3 per cent of cupreous chloride; at 40°, 6·0 per cent; and, at 14°, 3·6 per cent; while a solution with only 5 per cent of chloride of sodium holds, of the cupreous chloride, at 90°, 2·6, and, at 40°, only 1·1 per cent. These determinations are from single observations, and, therefore, require verification. From the sparing solubility of the cupreous chloride in dilute solutions of chloride of sodium, it follows that the denser saturated solutions are copiously precipitated by dilution with water, which causes the separation of white cupreous chloride in a crystalline condition.

2. The aqueous solutions of the chlorides of calcium, magnesium, zinc, manganese, cobalt, ferrosum, and cuprosum also freely dissolve cupreous chloride; and it is probable that this property is shared by other soluble chlorides. The strong affinity of cuprosum for chlorine enables cupreous oxide to decompose all the chlorides just named, with the exception of those of sodium and calcium, with separation of the corresponding oxides and formation of cupreous chloride. In the case of zinc and manganese, insoluble oxychlorides of these metals are formed at the same time. These reactions require further study; and the same may be said of the cupric and cobaltic chlorides with cupreous oxide. I have, however, partially investigated the behaviour of cupreous oxide with magnesic and ferrous chlorides, and obtained the results about to be described.

3. The cupreous oxide, for these experiments, was prepared by gently heating a solution of sulphate of copper, mixed with cane-sugar and an excess of caustic soda, until the whole of the copper was thrown down as a bright, dense cinnabar-red powder, which was carefully washed and dried. A concentrated solution of chloride of magnesium dissolves this oxide in the cold, and more readily when heated, with separation of hydrated oxide of magnesium and cupreous chloride, which latter is held in solution by the excess of magnesic chloride. By filtering the liquid while hot, and washing with a strong solution of chloride of sodium, the hydrate of magnesia may be separated, and the dissolved copper subsequently precipitated by metallic iron from the colourless filtrate, ferrous chloride being formed. Experiment shows that the reaction between the red oxide of copper and chloride of magnesium may be represented as follows:—

$$Cu_2O + MgCl = Cu_2Cl + MgO.$$

4. A solution of magnesian chloride, nearly saturated, when hot, with cupreous oxide, and allowed to cool in contact with the precipitated magnesian hydrate, deposits a portion of orange-coloured oxide, or perhaps an oxychloride, which disappears as often as the solution is heated. The solid cupreous chloride is, moreover, decomposed when digested with water and magnesia, hydrated cupreous oxide and magnesic chloride being formed. The double chloride of cuprosum and magnesium is, however, stable, even in the cold, in presence of magnesian hydrate, provided a considerable excess of magnesian chloride be present. From a filtered solution of cupreous oxide in chloride of magnesium, water precipitates a large portion of the cupreous chloride, in this case, coloured orange-yellow from adhering oxide, due to the reaction of a little magnesia which remains dissolved or suspended in the concentrated solution, even after filtration. A solution of magnesian chloride of sp. gr. 1·23 retains in solution, at 12° C., about 7·10 per cent of cupreous chloride. A solution of magnesian sulphate, with chloride of sodium, may be employed to dissolve cupreous oxide. This, like all similar solutions of cupreous chloride, rapidly absorbs oxygen from the air, and deposits a pale-green cupric oxychloride.

5. With ferrous chloride and cupreous oxide, it might be expected, from analogy with the magnesian salt, that we should obtain cupreous chloride and ferrous oxide; but the reaction is complicated by the tendency of the latter to pass to the state of ferric oxide. When ferrous chloride in solution with chloride of sodium is heated with a sufficient quantity of cupreous oxide, the whole of the iron is precipitated as ferric oxide, mingled with metallic copper, while cupreous chloride remains in solution. Experiments made with an excess of ferrous chloride show that one-third of the copper is reduced, while two-thirds are dissolved as dichloride. This reduction may be effected directly by ferrous oxide. If, to a solution of cupreous chloride in chloride of sodium, we add hydrated ferrous oxide recently precipitated by an alkaline base and still suspended in the liquid, it is at once converted into ferric oxide, with precipitation of metallic copper. The first stage in the action of ferrous chloride on cupreous

* Read before the American Association for the Advancement of Science, at Salem.

oxide may be represented as similar to that of magnesic chloride, $Cu_2O+FeCl=Cu_2Cl+FeO$; in the second stage, $Cu_2Cl+3FeO=Cu_2+FeCl+Fe_2O_3$. It follows from this that one-third of the cupreous chloride formed in the first stage is reduced to the metallic state; and the final result may be represented as follows:—

$$3Cu_2O+2FeCl=2Cu_2Cl+2Cu+Fe_2O_3.$$

A similar result is obtained if ferrous chloride is added to an unfiltered solution of cupreous oxide in chloride of magnesium. The suspended hydrate of magnesia, in this case, liberates an equivalent of ferrous oxide, which reduces to the metallic state one-third of the dissolved cupreous chloride, in accordance with the second reaction given above.

6. The reducing power of ferrous oxide is also shown with cupric chloride, which is at once converted by it into cupreous chloride, in accordance with the equation $2CuCl+3FeO=Cu_2Cl+FeCl+Fe_2O_3$. The further action of ferrous oxide will, as we have seen, reduce the cupreous chloride to the metallic state; in fact—

$$2CuCl+6FeO=2Cu+2FeCl+2Fe_2O_3.$$

If recently-precipitated hydrated ferrous oxide or ferrous carbonate be added to a solution of cupric chloride in the proportions indicated by the last equation, the whole of the copper is separated in the metallic state, mingled with ferric oxide; while ferrous chloride is found in solution. The reaction with ferrous carbonate, which requires a gentle heat, is accompanied by a violent disengagement of carbonic-acid gas. This experiment is best made by dissolving in water ferrous sulphate and sodic carbonate, or sodic hydrate, in the proportions required, and adding thereto a solution holding the proper amount of cupric chloride. Under certain conditions, the cupreous precipitate is brownish black in colour, like that obtained by heating ferrous chloride with cupreous oxide; but more generally it is of a bright red colour, and often coats the glass with a mirror-like film. A warm solution of cupric chloride with chloride of sodium at once converts the metallic copper of the precipitate into cupreous chloride, which is dissolved, leaving behind only hydrated ferric oxide. When a solution of ferrous chloride with chloride of ammonium and excess of ammonia is added to a solution of a copper-salt, the precipitated films of metallic copper sometimes possess considerable brilliancy, and show a bluish translucency. It is to be remarked that, although the cupreous precipitate thus obtained is bright red in colour, that which is produced by boiling cupreous oxide with ferrous chloride is nearly black.

7. It was long since shown by Levol that hydrated ferric oxide will reduce cupric to cupreous oxide; and this, as we have already seen, can separate from its combinations ferrous oxide, whose reducing power may be still further exerted upon the cupreous combination thus formed. These facts serve to explain the results obtained by E. Braun (*Zeitschr. Chem.*, 1867, p. 568; cited in *Jahresberichte* for 1867), which were not known to me at the time of making these experiments. He found that, by digesting cupric hydrate or cupric carbonate with ferrous sulphate in solution, there was obtained a reddish mixture of basic ferric sulphate with cupreous oxide, formed, apparently, in accordance with the equation—

$$2FeO,SO_3+2CuO=Cu_2O+Fe_2O_3,2SO_3.$$

This, when boiled with a further portion of ferrous sulphate, became black in colour, and, from the small amount of oxygen present, was supposed to contain metallic copper. By adding a large excess of carbonate of ammonia to a mixture of ferrous and cupric sulphates, Braun succeeded in obtaining solutions in which all the copper was present in a cupreous form, and even in reducing portions of it to the metallic state—a process which we have seen is complete when the requisite amount of ferrous oxide is brought in contact with the chlorides of copper.

8. In *Silliman's Journal* for March, 1867, p. 308, I described briefly the reaction between cupric oxide and ferrous chloride according to the equation—

$$3CuO+2FeCl=Fe_2O_3+Cu_2Cl+CuCl.$$

I was not then aware that the same had been shown by Meyer (*Berg. und Hutt. Zeit.*, 1862, p. 182; cited by Kerl).* Further studies of this reaction have given me interesting results. The black oxide of copper, even after ignition, is attacked by ferrous chloride in the cold; but the insolubility of the resulting cupreous chloride retards the action. If, however, the ferrous chloride be mingled with a strong solution of chloride of sodium, and heat applied, the cupreous chloride is readily dissolved, and the reaction is rapid and complete, the whole of the iron separating as a bulky, reddish brown precipitate, provided 3 equivalents of cupric oxide have been taken for 2 of ferrous chloride. The greenish solution thus obtained readily dissolves precipitated metallic copper, in virtue of the cupric chloride which it contains, and, unless a large excess of chloride of sodium be present, deposits white crystalline cupreous chloride by cooling or by dilution. When digested, at a temperature of 50° C., with carbonate of lime, the greenish solution deposits one-third of its copper as a pale green, insoluble, cupric hydrocarbonate, while the colourless filtrate retains the remaining two-thirds in the form of cupreous chloride. If a solution of ferrous chloride with chloride of sodium is digested with a sufficient excess of cupric oxide, the cupric chloride formed unites with the latter to form an insoluble cupric oxychloride, and only cupreous chloride remains in solution.

9. For the ferrous chloride in the experiments in Nos. 5 and 8, a solution of ferrous sulphate with chloride of sodium may be substituted. When cupric oxide is heated with an excess of ferrous chloride, a small portion of ferric oxychloride is produced. The red-brown precipitate may be washed free from cupric, cupreous, and ferrous chlorides by a strong solution of chloride of sodium, but will then yield to pure water a portion of soluble ferric oxychloride. By careful desiccation in a water-bath, and subsequent washing with dilute alcohol, the ferric precipitate may be obtained free from chloride of sodium, and completely insoluble in water; but its composition appears to be variable. Of two preparations, the first contained 1 equivalent of chlorine for 11, and the second 1 for 20 equivalents of iron. In another experiment, where fine oxide of copper from the calcination of malachite was dissolved in an excess of a mixture of ferrous sulphate and chloride of sodium at a boiling heat, it was found that, for 30 equivalents of copper dissolved, there were precipitated 21 equivalents of iron, instead of 20, as required by the formula given in No. 8; the additional equivalent being separated as ferric chloride in union with the ferric oxide. The production of a small and variable amount of ferric chloride in the above conditions is apparently due to a secondary reaction between cupric and ferrous chlorides in the presence of ferric oxide, $2CuCl+2FeCl=Cu_2Cl+Fe_2Cl_3$. This point, however, requires further investigation.

10. The facility with which cupric chloride parts with one-half of its chlorine, and passes into the more stable cupreous compound, is shown by its well-known power to chloridise, not only metallic copper, but metallic silver, and even sulphide of silver. Its action on cupreous sulphide is not less remarkable. A strong solution of cupric chloride, mingled with chloride of sodium, rapidly attacks pulverised copper-glance, even in the cold, sulphur being separated and cupreous chloride formed—

$$2CuCl+Cu_2S=2Cu_2Cl+S.$$

Chalcopyrite, on the contrary, is but slightly acted upon by such a solution, which, however, slowly takes up a portion of iron, forming ferrous chloride with a corresponding amount of cupreous chloride.—*American Journal of Science.*

* "Metall. Huttenkunde," vol. xi., p. 588.

ON THE

ABSORPTIVE POWER OF SOIL.*

By ROBERT WARINGTON, F.C.S.

(Continued from p. 210.)

WE now pass to the experiments made in the college laboratory,† after an account of which we will attempt a review of the whole subject.

The investigation we are about to describe was confined to the single inquiry, What is the part taken by oxide of iron and alumina in the absorptive action of soils? In *Practice with Science*, vol. i., p. 333, an account has been already given of the earliest of these experiments. It was then stated that both hydrated oxide of iron and alumina possessed in a remarkable degree the power of removing phosphoric acid from the solution of a phosphate. The experiment was made with a solution of phosphate of calcium in carbonic acid water, and it was found that by contact with a relatively small bulk of either of these hydrates, 96 to 97 per cent of the phosphoric acid originally present was withdrawn, while the calcium was left dissolved in the liquid in the form of carbonate. The chemical decomposition of the phosphate of calcium was thus all but complete; a basic phosphate of either iron or aluminium was produced, and the calcium, at the end of the reaction, was united to carbonic in place of phosphoric acid. These results suggested the question, Whether the property of soils of withdrawing phosphoric acid from the solutions of its salts was not owing to the presence in soils of oxide of iron and alumina? whether, in fact, the absorption of phosphoric acid was not a simple consequence of the chemical affinity existing between it and these hydrated oxides? The next experiments were made with the object of testing the correctness of this conclusion. Did soil comport itself towards a solution of a phosphate in a manner similar to that shown by oxide of iron under the same circumstances?

In the experiments with soil, the same method was followed as in the experiments with the pure hydrated oxides. The soil was placed in contact with a solution of phosphate of calcium in carbonic acid water, the liquid being kept saturated with the gas, and, after some days, the amount of calcium and phosphoric acid removed from the solution was ascertained. If no chemical action had been exerted by the soil, the phosphate of calcium would be either undiminished or else absorbed without decomposition, in which case equal proportions of calcium and phosphoric acid would be removed from the solution. If, however, the soil acted in a manner similar to the oxide of iron, the phosphate of calcium would be more or less decomposed, its acid withdrawn, while the calcium remained dissolved. A little reflection, however, showed that perfectly sharp results could not be expected in experiments with soils, from their well-known behaviour towards solutions of carbonic acid and solutions of calcium salts. A soil containing lime will give up a portion of it if treated with a solution of carbonic acid. If such a soil were used for the experiment, calcium might be expected to pass from the soil into the solution; and if, at the same time, a portion of the phosphate were absorbed, it would appear as if the phosphate had been decomposed without this having perhaps occurred, since an excess of calcium would be shown by analysis to exist in the remaining solution. On the other hand, most soils absorb carbonate of calcium from its solution in carbonic water; and operating with such a soil, the carbonate of calcium, resulting from the decomposition of the phosphate, would itself be absorbed by the soil, and thus the evidence of the decomposition be lost.‡ It was thought safer to avoid the former error, and to choose soils for the trial which did not yield calcium to carbonic acid water, since, in this case, though the decomposition of the phosphate might appear but small, from the subsequent absorption of the carbonate of calcium, there could be no question as to its reality if found to occur to any appreciable extent.

The two soils employed had the following composition:—

	Soil A.	Soil B.
Moisture	1·54	6·57
Organic and volatile matter ..	3·69	17·03
Silica and insoluble silicates ..	87·31	55·29
Oxide of iron and alumina ..	6·82	19·31
Phosphoric acid	0·05	0·34
Lime	0·11	0·28
Magnesia	0·14	0·63
Potash	0·16	0·55
Carbonic acid, traces of other substances, and loss	0·18	
	100·00	100·00

Notwithstanding the very small amount of lime in these soils, they were found to give up some of it when digested with carbonic acid water. The portion of soil taken for experiment was, therefore, repeatedly digested with carbonic water, and as this removed the lime but slowly, the soils were, in the earlier experiments, further treated with weak acetic acid, and then thoroughly washed with water: all soluble calcium salts were thus removed.

In the first two experiments, 600 grms. of soil were treated with 8000 grms. of a solution of tricalcic phosphate in carbonic water, and carbonic acid gas was passed through the mixture from time to time. At the end of eighteen days the solution was removed from the soil and analysed. Analysis showed that soil A had absorbed 50·8 per cent of the phosphoric acid originally present, and 43·2 per cent of the lime; while soil B had absorbed 96·1 per cent of the phosphoric acid, and 61·5 per cent of the lime.

The experiment with soil B was once more repeated: the soil was this time not treated with acetic acid, but washed with carbonic water only. 400 grs. of the soil were treated as above with 800 grs. of a solution of tricalcic phosphate. After six days the liquid was removed and analysed. The soil had, in this instance, absorbed 93·8 per cent of the phosphoric acid, and 49·0 per cent of the lime.

In all these experiments there was evidently a decomposition of the phosphate of calcium by the soil, this being most marked in the case of soil B; in each experiment there was, however, a very considerable absorption of lime as well as of phosphoric acid. It was, in fact, proved in every case that a part of the phosphoric acid absorbed had been withdrawn by chemical action, but in no case did the proof extend to the whole of the phosphoric acid removed by the soil. We have already noticed that the property possessed by soil of absorbing carbonate of calcium from its solution in carbonic acid, necessarily deprived us of the evidence requisite to complete the proof.

That there might be no doubt that the soils experimented with had the faculty of removing carbonate of calcium from a carbonic solution, a trial was made with soil B—the soil which had given the greatest absorption both of lime and phosphoric acid. 400 grs. of this soil were placed in contact with a weak solution of carbonate of calcium in carbonic acid water, the experiment being conducted as before. At the end of six days the soil had withdrawn 27·4 per cent of the carbonate of calcium present.

The experiments with soil might, doubtless, have been extended with advantage; the evidence was, however, sufficient to convince me that the natural hydrated oxide of iron contained in soil behaved in the same manner

* *Practice with Science*, vol. ii.

† These experiments were made by the writer in 1865—7, while assistant teacher of chemistry at the college.

‡ Theoretically there would be for every soil a certain strength of solution of carbonate of calcium in carbonic water, in which the soil would neither give up nor absorb lime.

towards phosphoric acid as the artificially prepared hydrate had been found to do in the earlier experiments.

The concluding investigation was upon the absorptive power of the hydrated oxides for salts of potassium and ammonium. Hydrated oxide of iron and hydrated alumina were prepared by precipitation; they were very thoroughly washed by decantation before use. Known quantities of these hydrates and of the various salt solutions were then mixed, and after contact for a day or two the amount of absorption was ascertained by an analysis of the liquid. The following tables show the amount of absorption ascertained for each salt; the figures given are in most cases the mean of several experiments:*—

Absorption of Salts of Potassium by Hydrated Ferric Oxide and Hydrated Alumina.

Salt employed.	Strength of solution.		Amount absorbed by 100 of hydrated ferric oxide ($Fe_4H_6O_9$)†		Amount absorbed by 100 of hydrated alumina ($Al_2H_6O_6$)†	
	Per cent of salt.	Per cent of potash.	Calculated as salt.	Calculated as potash.	Calculated as salt.	Calculated as potash.
Carbonate of potassium	0·995	0·678	7·17	4·89	1·49	1·02
Sulphate of potassium	1·077	0·582	1·94	1·05	0·55	0·30
Chloride of potassium	1·053	0·664	0·36	0·23	No trial.	—
Nitrate of potassium	1·049	0·488	0·38	0·18	0·27	0·12

Absorption of Salts of Ammonium by Hydrated Ferric Oxide and Hydrated Alumina.

Salt employed.	Strength of solution.		Amount absorbed by 100 of hydrated ferric oxide. ($Fe_4H_6O_9$)†		Amount absorbed by 100 of hydrated alumina. ($Al_2H_6O_6$)†	
	Per cent of salt.	Per cent of ammonia.	Calculated as salt.	Calculated as ammonia.	Calculated as salt.	Calculated as ammonia
Carbonate of ammonium	0·930	0·329	5·40	1·91	2·04	0·72
Sulphate of ammonium	1·382	0·356	2·17	0·56	0·74	0·19
Chloride of ammonium	0·958	0·304	0·20	0·07	No trial.	—
Nitrate of ammonium	1·552	0·330	0·35	0·08	No trial.	—

Two points strike us at once on inspecting these tables.

In the first place, the absorbent action of alumina is clearly much less than that of ferric oxide. With carbonate and sulphate of potassium the oxide of iron takes up about four times as much as the alumina; with the corresponding ammonium salts it takes up about three times as much as the alumina.

In the next place, it is very evident that both with oxide of iron and alumina the amount of absorption varies greatly with different salts of the same base.‡ The carbonates of potassium and ammonium are seen to have been absorbed to a considerable extent, the sulphates to a small extent, while of the chlorides and nitrates only traces were taken up. This order of absorption, it will be remarked, is the same as that generally observed in absorption by soil. With soil, however, the absorption from the sulphate, chloride, and nitrate, is proportionately far greater than in the present case. The difference is, doubtless, owing to the important assistance given by the lime of soil, which, combining with the acids of these salts, allows the bases to be absorbed as hydrates. It was attempted in a few experiments to imitate the conditions of soil by adding carbonate of calcium to the hydrated oxides. Some further absorption was obtained in a few cases by this means, but the imitation of the conditions of soil was clearly very imperfect.

It was a point of great importance to decide if the absorption in these experiments was due to a chemical or a physical action. With this view attention was paid to any evidence of a decomposition of the salt during the reaction.

In the case of carbonate of potassium, it was found that the carbonic acid was not absorbed to the same extent as the potassium, but that an excess of acid remained in every instance in the final solution. In three experiments with hydrated ferric oxide there were absorbed for ten equivalents of potassium, 3·6, 4·5, and 7·9 equivalents of carbonic acid. The proportion of carbonic acid absorbed was thus very various. The variation was evidently connected with the amount of potassium removed from solution, as the following figures will show:—

	Potassium absorbed for 100 originally present.	Equivalents of Carbonic Acid absorbed for 10 of Potassium.
Experiment 1	6·84	3·6
Experiment 2	18·67	4·5
Experiment 3	32·57	7·9

Thus, the weaker the solution became during the absorption, the greater was the proportion of carbonic acid taken up. It seems that ferric oxide commences by absorbing potash almost to the exclusion of carbonic acid; by so doing, the proportion of carbonic acid in the liquid must be increased. But this accumulation of acid in the liquid appears to act as a check on the further decomposition of the potassium salt, which, therefore, takes place to a less and less extent as the absorption progresses. In one experiment with hydrated alumina, the decomposition of the carbonate of potassium was complete, potash was taken up, but no carbonic acid.

In the experiments with carbonate of ammonium, the absorption of carbonic acid was determined in one instance only. The ferric oxide in this case absorbed carbonic acid and ammonia in the proportions to form neutral carbonate; the salt used had contained, as is usual with the commercial article, an excess of carbonic acid—a slight decomposition had therefore probably taken place.

In the experiments with sulphates, it was noticed that the solution of sulphate of ammonium became distinctly alkaline on contact with either ferric oxide or alumina; with the latter the reaction was very marked. A determination of the amount of sulphuric acid and ammonia removed by the alumina showed that, for 10 equivalents of ammonia, 28·2 equivalents of sulphuric acid* had been

* For the analytical details the reader is referred to the *Journal of the Chemical Society*, vol. vi., p. 1.

† These formulæ represent the composition of the hydrates actually employed.

‡ The reader will observe, by reference to the table, that the strength of the salt solutions employed was not in every case regulated by the chemical equivalent of the salt. In this, and several other particulars, the experiments admit of considerable improvement. These errors, pointed out by experience subsequently gained, do not, however, affect any of the conclusions here drawn.

* By an equivalent of sulphuric acid, is here understood the amount required to form sulphate of ammonium with 1 equivalent of ammonia.

taken up. The acid had here been absorbed in far greater proportion than the base. Solution of sulphate of potassium became slightly alkaline on contact with alumina; with oxide of iron, no change was observed.

Solutions of chloride and nitrate of ammonium became alkaline on contact with ferric oxide, showing that the acid was taken up to a greater extent than the base; the parallel experiments with alumina were here wanting. The corresponding potassium salts were unaffected by contact with ferric oxide.

We have here very distinct evidence that the absorption by ferric oxide and alumina was attended with a chemical decomposition of the salt absorbed; this decomposition was, however, rarely complete, both acid and base being in most cases taken up, though in unequal proportions. To a chemist, alumina and ferric oxide are known to behave as feeble bases towards strong acids, and as feeble acids towards strong bases; we can, therefore, from a chemical point of view, readily understand the preponderating absorption of base from the salt of a weak acid, as a carbonate, and the preponderating absorption of the stronger acids from their comparatively feeble combinations with ammonium. Again, the well-known readiness with which ferric oxide and alumina form highly basic compounds, and also salts (as alum) containing two bases to one acid, seems to render a purely chemical explanation of the whole of these reactions quite easy. It is not, however, denied that hydrated ferric oxide and alumina are capable of taking up certain substances by virtue of physical attraction, but it is believed that such an action has had no place in the absorption of the salts here described.

A single experiment was made as to the retention of potash by ferric oxide when the latter was washed with water. Hydrated ferric oxide which had absorbed potash from the carbonate was submitted to two washings with thorough agitation, each washing remaining in contact one day. The ferric oxide was then found to have lost two-thirds of its potassium. The washing was sufficient to have reduced a perfectly soluble salt to $\frac{1}{7}\frac{1}{3}$th its original quantity. The compound with iron was thus decomposed by water, but with some difficulty.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 5th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—G. Matthey, T. Steel, T. Allen.

Mr. BROWN read a paper "*On Vapour Densities*," wherein he gave a historical review of the various methods employed for the determination of vapour densities.

Mr. CHURCH communicated "*The Analyses of Two Cornish Minerals*."

The one, restormelite, was obtained from the Restormel Iron Mines, and may be regarded as a variety of kaolinite, standing nearest to the lithomarge group. Its specific gravity and its hardness are nearly the same as those of lithomarge. In its percentage of silica and alumina (its chief constituents) it does not differ from that of lithomarge; but, while restormelite contains 7 per cent of soda and potash, lithomarge contains a mere trace of these alkalies. Mr. Church considers restormelite as preserving in its alkalies more evident traces of its feldspathic origin than we usually find in such alteration-products. The following percentages were obtained in six analyses:—

	I.	II.	III.	IV.	V.	VI.
H_2O	11·69	—	11·75	11·64	11·65	—
SiO_2	—	—	44·77	45·66	—	—
Fe_2O_3	—	—	1·11	1·25	—	0·98
Al_2O_3	—	—	35·05	35·66	—	34·58
MgO	—	0·92	0·69	0·95	—	—
K_2O	—	2·10	2·51	—	—	—
Na_2O	—	4·12	4·12	—	—	—

These results correspond pretty well with the formula of kaolinite, $Al_2O_3 2SiO_2 + 2aq$, if we suppose several replacements, such as a partial replacement of hydrogen by sodium or potassium, and of aluminium by iron.

The other of the above-mentioned minerals is chalcophyllite. The recorded analyses of this mineral are by no means satisfactory. Chevenix found in it 58 per cent of cupric oxide, and 21 of water; Hermann, 44·45 per cent of CuO, and 31·19 of water; and Damour, 52·61 of CuO, and 23·26 of water. Of course, it was rather difficult to assign a formula for so variable a substance. Mr. Church has devoted much time and labour to an endeavour to clear up the mystery of its constitution; and he obtained the following percentage as the mean of several analyses:—

H_2O (lost at 100°)	14·06
CuO	46·14
Al_2O_3	5·97
Fe_2O_3	0·60
As_2O_5	15·54
H_2O (by difference)	31·75

These results lead to the formula—

$$8CuO, Al_2O_3, As_2O_5 + 24aq.;$$

or as well to $8CuO, Al_2O_3, As_2O_3 + 25aq.$; and these elements of chalcophyllite may be viewed as arranged in the following manner:—

$$\left.\begin{matrix} Cu_3(AsO_4)_2, 6aq. \\ 5CuH_2O_2 \\ Al_2H_6O_6 \end{matrix}\right\} + 11aq.;$$

Or—

$$\left.\begin{matrix} Cu_2H_2(AsO_4)_2, 5aq. \\ 6CuH_2O_2 \\ Al_2H_6O_6 \end{matrix}\right\} + 11aq.$$

It ought to be stated that chalcophyllite cannot be dried, even *in vacuo*, without an entire change in its appearance; the transparent beautiful green crystals become opaque and of a more bluish green. These changes correspond to a loss of 13·79 per cent of water. At 100°, the insignificant further loss of 0·31 per cent of water takes place.

Messrs. BOLAS and GLOVES communicated a paper on "*Tetrabromide of Carbon*."

This combination is obtained (1) by heating bisulphide of carbon with bromide of iodine, in a sealed tube, to a temperature of 150° C. for about 48 hours; (2) by heating bromopicrin with bromide of iodine in a flask furnished with a digestion-tube till the reaction is completed, which is indicated by the disappearance of the bromopicrin; (3) by heating bromoform with bromide of iodine, in a sealed tube, to about 150° C. for 24 hours.

In all the above processes, terbromide of antimony may be substituted for the bromide of iodine. The tetrabromide of carbon is obtained in a pure state by distillation. It is a white substance, crystallising in lustrous plates, melting at 91° C., of an ethereal odour, somewhat resembling that of carbon tetrachloride, and of sweetish taste. It does not dissolve in water, but readily in ether, hot alcohol (from which it is deposited, on cooling, in the crystalline state), carbon bisulphide, chloroform, bromoform, benzol, and American oil. Sodium amalgam reduces it to bromoform, and then into methylene dibromide.

The authors propose to carry on their investigations of this interesting compound.

CORRESPONDENCE.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—I cannot see how your correspondent "O. V." can have deduced from my letter the statement that "Mason's ores require much less nitre *per* 100 *parts of sulphur burnt* than do other ores. My statement was that 100 parts of sulphur (meaning pure brimstone) required, in the hands of different manufacturers, varying proportions of nitrate of soda; and I ventured the opinion that the variation was due to a want of uniformity in the conditions of the manufacturing process.

The subsequent mention of Mason's ores is accounted for by the absence of precise information as to whether Mr. Spence used brimstone or sulphur ores in his process.

I have had experience of Mason's ores, and find them very manageable; but, of course, the quantity of nitrate used with different ores of sulphur will vary in direct proportion to the quantity of sulphur they contain.—I am, &c.,

DAVID BASIL HEWITT, B.A., T.C.D.

Manchester, May 7th, 1870.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—I transmit to you, herewith, copies of correspondence between Mr. P. Spence and myself, having reference to the papers which have recently appeared in your Journal relative to the production of sulphuric acid. Mr. Spence and I agree in thinking that the publication of the letters may serve to place the question under discussion in a clearer light.—I am, &c.,

J. W. KYNASTON, F.C.S.

St. Helen's, May 10th, 1870.

"St. Helen's,
"April 29th, 1870.

"Dear Sir,—Will you pardon the liberty I take in addressing you? but I have been very much interested in your account of your trial of Dr. P. W. Hofmann's suggestions as regards the economical production of sulphuric acid. As I read Dr. Hofmann's original paper, and his subsequent letter seems to confirm this view, the important point in his improvement is that the mixed sulphurous and nitrous acid gases should not be permitted to come in contact with vitriol of lower strength than 143° Twad. until a reaction has taken place between them, and that, if it should come in contact with acid of a lower density, a large proportion of the nitrous acid is decomposed, with production of free nitrogen. If this be a correct conclusion, it appears to me that your re-arranged plan of working (as described in the CHEMICAL NEWS for April 22nd) introduces the very evil Dr. Hofmann tells us we should avoid. The difficulty under which I labour in my study of the matter is that, notwithstanding this, you have actually succeeded in reducing considerably your consumption of nitrate, and that you, with your great practical experience, consider the saving to be due to your having adopted Dr. Hofmann's suggestion. Though I have myself paid much attention to this manufacture, I yet feel considerable diffidence in writing to you that the diminution in your requirements of nitrate of soda is owing to quite another cause, or perhaps more than one. But I suggest to you whether, in your plan of working, as described in the before-mentioned paper, you are not condensing a considerable proportion of your make of vitriol in the first two chambers, and that your two next chambers, while, of course, allowing the formation of more vitriol, play more distinctly the part of a Gay-Lussac's column or tower, the strong vitriol absorbing the nitrous gas, which, the vitriol being returned to the first chamber, is again evolved, and again becomes available for the same work as it had before performed. I have a strong opinion that the whole saving you have effected, and, I may add, the whole saving you expect to accomplish when your re-arrangements are complete, may be accounted for in this way alone, and without any consideration of Dr. Hofmann's suggestion. I should feel greatly obliged if you would favour me with your opinion upon the points I have called in question. To anyone engaged in the manufacture, economy in the use of nitrate is of the utmost importance; and I plead my anxiety on the subject as my excuse for troubling you with so long a letter.—I am, yours faithfully, J. W. KYNASTON.

"Peter Spence, Esq."

(REPLY).

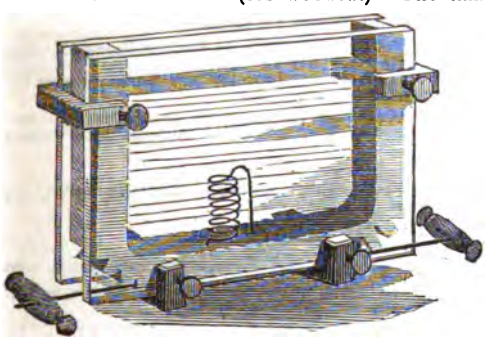
"Manchester,
"2nd May, 1870.

"Dear Sir,—I have much pleasure in answering your letter of 29th, to hand this morning. I am always ready to pick up any promise of improvement in the manufacture of sulphuric acid, and most ready to communicate all I know upon the subject. I therefore took up at once Mr. Hofmann's suggestion, and, although I did not, and do not now, believe in his theory, it at once suggested to me what you exactly describe as, in fact, the Gay-Lussac tower in principle, but without the apparatus. The theory of sulphuric acid production, as well as the facts of the Gay-Lussac process, in my opinion, disprove Mr. Hofmann's hypothesis. The theory is that the SO_2 and NO_4 unite to form sulphate of nitric oxide, which, by water or steam, is resolved into SO_3HO and binoxide of nitrogen, which, in contact with air, instantly forms NO_4 ready for a repetition of the process. Now, not one-tenth of NO_4 is sent into the chambers equivalent to combine with all the SO_2 going in at the same time: the combination must, then, be made at least ten times (I should probably be more correct by saying twenty times, but ten is sufficient). If, then, 10 per cent of the nitric oxide is destroyed each combination, it would all be destroyed when the process is completed. Yet I have seen the Gay-Lussac process at work when, after, I think, ten chambers had been traversed, it took up so much of the binoxide of nitrogen that only one-fourth of the usual amount of nitrate of soda was required. Now, the Gay-Lussac process is not perfect, and probably one-fourth would escape its operation. No decomposition into nitrogen can therefore take place. I have little doubt Mr. Hofmann's first chamber would act by the strong acid at bottom reacting upon his gases, and affording them NO_4. I am sorry I cannot as yet give you any decided results as to full success from the adoption of my scheme in its integrity. I only got all the connections made in the end of the week, and to-day my two strong chambers are getting up to the point I shall keep them at, namely, 143° Twad.; but, so far, I see no reason to doubt that at least a considerable saving of nitrate will be effected, and more than the practical trial gave me. I probably gave Mr. Hofmann more credit than I should have done, as I never believed his theory; but it was entirely to his suggestion that my effort was due, and in that case I could not claim as an originator, but merely as improving upon a suggestion. I may say that a very large production of acid takes place in my No. 1 chamber; but my No. 2 and 3 also produce largely, and all their production is now going into No. 1 loaded with NO_2, and is taken out of No. 1 for use with almost no nitric oxide in it, or not more than I have usually had. If I can effect the expected saving, my only difficulty will be wear and tear of lead.—Yours very truly, (Signed) PETER SPENCE.

MISCELLANEOUS.

The Royal Society.—The following gentlemen are recommended by the Council for election into the Royal Society, on June 2nd:—William Froude, C.E.; Edward Headlam Greenhow, M.D.; James Jago, M.D.; Nevil Story Maskelyne, M.A.; Maxwell Tylden-Masters, M.D.; Alfred Newton, M.A.; Andrew Noble, Esq.; Captain Sherard Osborn, R.N.; Rev. Stephen Parkinson, B.D.; Captain Robert Mann Parsons, R.E.; William Henry Ransom, M.D.; Robert H. Scott, Esq.; George Frederic Verdon, C.B.; Augustus Voelcker, Ph.D.; Samuel Wilks, M.D.

Solar Eclipses.—Through the kindness of Prof. Henry Morton we are enabled to give a brief account of a lecture on the above subject given by him for the benefit of the Franklin Institute. We have before had occasion to refer to the popularity of this eminent lecturer, as well as to the enormous scale on which he conducts the most successful experiments; and the lecture on solar eclipses, which was demanded a second time, illustrated as it was with the most brilliant experiments, fully sustains the high reputation he has gained both in the old and new world. After describing experimentally the causes of an eclipse, the umbra and penumbra, the law of direction, the total eclipse, and the prominences, the lecturer proceeded to illustrate the formation of solar prominences by means of a tank and a coil of wire (see woodcut). The tank is



filled with water, and then a solution of cochineal is run in on the bottom with a pipette. A single flask cell excited with bichromate of potash and sulphuric acid is enough to determine the ascending current, which carries up the crimson solution in a very beautiful manner. By interrupting the circuit, the red prominence can be made to settle back, or topple over, so as to assume many of the forms actually observed. To erect the image on the screen, Professor Morton used one of Zentmayer's erecting prisms.* Mr. J. N. Lockyer's drawings of solar prominences, pictures of the corona and its coruscation, illustrated by a new piece of apparatus for the lantern, and producing on an immense scale the beautiful effects shown by the chameleon top, were very clearly shown.

Existence of Tin in California.—At an exhibition of the agriculture, and manufacturing and mineral resources of California, held last year at San Francisco, sacks of ore, bars of tin-plate, of the heaviest quality, and utensils of every sort for domestic use, which were manufactured from Californian ore, were there collected. Many doubted and shook their heads at this display of a long-desired but unusual manifestation of riches; but, since then, additional information and additional specimens of ore have been forwarded to the United States General Land Office at Washington, and an average sample of the same has been submitted for analysis to the able and distinguished chemist and mineralogist Dr. F. A. Genth, who reports that it contains 13·37 per cent of tin. The black mineral in the ore is tourmaline (it contains boracic acid), and the brownish red is the cassitterite. It is a highly-interesting occurrence, and the yield of tin is almost twice as much as the usual working ores of the tin-mines of Cornwall, England. The property is said to consist of 50,000 acres of mining lands; and over twenty openings have been effected, from all of which the ore is extracted—*Journal of the Franklin Institute.*

* *Journal of the Franklin Institute*, vol. liii., p. 407.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, May 2 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Cause of the Electric Currents Produced by the Contact of Metals and Distilled Water.—E. Becquerel.—The chief result arrived at by the author's experiments may be summarised thus:—The electrical effects produced by the contact of non-oxidisable metals and distilled water (chemically pure) are due, not to any special action of contact, but to the reaction of the water upon the gases condensed on the surface of these metals. The effects vary according to the molecular state of the metals and their temperature. As regards, however, the oxidisable metals, the electrical effects produced by heating them are due to the very slight layer of oxide adhering to their surface, whereby they are rendered positive towards the unpreserved metallic surface.

Observations on M. Croullebois's Paper "On the Index of Refraction of Water."—J. Jamin.

Reply to the Note of M. Renou "On the Latent Heat of Ice, as Deduced from the Experiments of Laplace and Lavoisier."—J. Jamin.

Crystalline Form and Optical Properties of a Combination of Protochloride of Platinum and Triethyl-Phosphine Analogous to Magnus's Salt.—J. des Cloizeaux.

Constitution of Luminous Spectra.—Lecoq de Boisbaudran.—The author calls attention in this paper to the fact of the analogy which exists between the spectra of the isomeric compounds—for instance, the alkaline chlorides, bromides, and iodides. The author further observes that the following spectral groups, each containing three bodies, may be made up, each of which exhibits greater analogy mutually, than with the rest of the groups—

K	Ca	Cl
Rb	Sr	Br
Cs	Ba	I

Researches on the Calorific Spectra.—P. Desains.—Reserved for full translation.

Observations on the Results Obtained by M. Croullebois, as regards the Index of Refraction of Water.—A. Cornu.

Combustibility of Diamonds, and the Effect of a High Temperature on these Gems.—Prof. Morren.—The author, in a letter, first relates the following facts, as having given rise to his experiments:—A jeweller at Marseilles, an excellent workman, well up to his trade, was requested to enamel afresh the golden bearings of two large diamonds of great value, used as shirt buttons. Instead of taking off the diamonds, always a delicate operation, the jeweller, who had frequently executed such work previously, decided to enamel the gold while the diamonds were left on their bearings. Not happening to have charcoal at hand, the jeweller took coals for heating the muffle for enamelling, an operation which succeeded most perfectly; but, on taking the buttons from the muffle, the jewels had become perfectly black, and no amount of rubbing or friction restored them to their pristine state. The jeweller was, therefore, obliged to dismount the jewels, which looked like plumbago, and to send them to Paris, where, by the first touch of the lapidary's wheel, they became restored to their former beauty, while, curiously enough, their weight had not changed. The author, who, through the kindness of MM. Laurin, jewellers, at Marseilles, was enabled to experiment with several diamonds, placed these on a small platinum boat in a platinum tube, and tried the effect of a high temperature simultaneously with different gases. Heated in coal-gas, the gems become blackish, increase in weight, and are found to be coated with a strongly-adhesive layer of carbon, such as is deposited in gas retorts; in pure hydrogen, the gems may be heated almost to the melting-point of platinum without undergoing any change; heated in carbonic acid gas, the gems become dull and lose a little weight

The carbonic acid gas was found to be dissociated into carbonic oxide and carbonic acid; this, the author found, was caused by the platinum and not by the diamond. When the diamond is placed in oxygen gas, and ignited, it continues to burn, but remains white, appearing as a piece of unpolished glass; the stone does not blacken, nor swell up, and, if it is free from flaws or cracks, does not divide asunder.

Process Suitable for Estimating the Rapport existing between the Dynamical Force Applied and the Quantity of Electricity Produced in Holtz's Machine.—E. Bouchotte.

Solubility of the Chloride, Iodide, and Bromide of Silver in Salts of Mercury.—H. Debray.—The main gist of this paper is, that the insoluble chlorides, iodides, and bromides of silver, and also of mercury, are soluble, to a greater or less extent, in the soluble persalts of mercury, especially at a high temperature, and that, on cooling, some of these haloid salts crystallise; and in that state the chloride of silver perfectly resists the action of light, which the author attributes to the presence of traces of mercury.

New Method for the Volumetrical Estimation of Copper.—F. Weil.—This process is based on the two following facts:—(1) In the presence of free hydrochloric acid, and at a boiling heat, the very slightest trace of bichloride of copper present causes the liquid to assume a very marked yellow-greenish tinge, and this is the stronger the more hydrochloric acid is present. (2) Protochloride of tin causes, at that temperature, the immediate reduction of the salts of oxide of copper dissolved in hydrochloric acid to salts of the suboxide of copper, which, in solution, are absolutely colourless; the reaction takes place according to the formula $2CuCl+SnCl=Cu_2Cl+SnCl_2$. Any single drop of chloride of tin added in excess may be at once detected by the addition of a drop of a solution of corrosive sublimate (bichloride of mercury), which causes the formation of calomel. If the solution of copper contains iron also, the quantity of chloride of tin applied will indicate the joint quantities of iron and copper present.

Products of the Fermentation of Pyro-Tartaric Acid and its Homologues.—A. Béchamp.—Contrary to what, according to the author, might be expected, when pyro-tartaric acid ferments under the influence of the microzymas of chalk—viz., formation of butyric acid according to the formula—

$$C_{10}H_6O_6,2CaO+HO=C_8H_7O_2CaO+CaOCO_2+CO_2,$$

the result obtained by actual experiment is, that no volatile acid is formed at all, and that only carbonate of lime remains; while carbonic acid and marsh gas are given off according to the formula—

$$2(C_{10}H_6O_8,2CaO)+8HO=5C_2H_4+4CaOCO_2+6CO_2.$$

Preparation of Pyro-Tartaric Acid.—A. Béchamp.—The author first thoroughly deprives of its water of crystallisation the tartaric acid to be submitted to dry distillation, next mixes that material with previously-ignited pumice-stone, and submits that mixture to dry distillation. In this way, 1600 grms. of tartaric acid yield 325 grms. of crude, but crystalline, pyro acid, which is best purified by means of alcohol of 90 per cent.

Minerals Found in the Cap Garonne (Département du Var) Copper Mine.—F. Pisani.—Among the many minerals here described the analysis of only one is given—viz., of adamine, a rather rare substance, first discovered in Chili. It consists, in 100 parts, of—Arsenic acid, 38·50; oxide of zinc, 52·50; oxide of cobalt, 3·92; water, 3·57. A cupriferous adamine was found to contain, also, in percentages—Arsenic acid, 39·85; oxide of zinc, 31·85; oxide of copper, 23·45; oxide of cobalt, 0·52; lime, 0·87; water, 3·68.

Observations on M. Duclaux's Paper "On the Formation of Drops of Liquids."—Dr. Limouzin.

Observations on the Effects of the Aurora Borealis of the 5th of April last on the Telegraphic Wires in the Ottoman Empire.—Dr. Lacoine.—The author describes, at length, the very peculiar effects alluded to, which, for a time, made all telegraphy quite impossible, owing to the counter currents excited in, or, at least, conducted by, the wires.

Death of Professor Lamé.—At the opening of the meeting, the President announced the death of Prof. Lamé, a member of the Institute since 1843. The deceased, a very celebrated physicist and mathematician, was born in 1795, educated at the Ecole Polytechnique, and was for some time engineer in the Russian service. On his return to France, he was appointed Professor of Physics at the above-named school, and remained in that capacity until the year 1845, when he was elected Examiner of the school. In the year 1848, he was appointed Professor of the Faculty of Sciences at Paris. Among his very many published works, those on mathematics and on the elasticity of bodies are the most celebrated.

Revue Hebdomadaire de Chimie, April 21, 1870.

Method for Extracting Sugar from Liquids which Contain that Substance, and its Combinations with Saline Matters.—M. Lair.—"Suppose," says the author, "any saccharine fluid: I add thereto lime in proper (but not specified) proportions, and heat to a temperature varying from 110° to 159° (under pressure, of course); by which proceeding saccharate of lime is precipitated, which is separated from the fluid either by filtration or decantation, and next treated by the ordinary well-known methods for the extraction of sugar from that lime-compound."

Application of Picric Acid for Imparting to Ivory, Bone, and Horn a Beautiful Red Colour.—C. Mène.—After giving a short account of the well-known properties of picric acid, the author describes the process alluded to as follows:—"Take 4 grms. of picric acid, and dissolve in 250 grms. of boiling water; add, after cooling, 8 grms. of liquid ammonia. Dissolve also 2 grms. of crystallised fuchsine (magenta) in 45 grms. of alcohol, dilute with 375 grms. of hot water, and next add 50 grms. of ammonia. As soon as the red colour of the magenta solution has disappeared, the two solutions are mixed together, making a bulk of liquid amounting to about ½ litre, which is a sufficient quantity for dyeing from four to six sheep's skins. Ivoy and bone should be placed in very weak nitric or hydrochloric acids first, before being immersed in the ammoniacal liquid; wood cannot be dyed by this liquid, unless it has been previously painted over with paste made from flour. When, to the ammoniacal liquid, some gelatine solution be added it may serve as a red ink which does not attack steel pens. By varying the proportions of the magenta and picric acid, the tints obtained may be varied from a bluish red to a bright orange-red. The desired colours do not appear until the ammonia is evaporated.

Nickelisation.—M. Gaiffe.—This paper, illustrated by a woodcut, gives practical details about the method applied by the author for the coating of metals with a more or less thick adhesive layer of nickel.

Method for Obtaining a Regular Stream of Sulphuretted Hydrogen Gas from Black Sulphide of Antimony.—Dr. Méhu.—In many parts of France, and especially in the south thereof, sulphide of antimony is regularly used for the disengagement of sulphuretted hydrogen; of course, hydrochloric acid and heat have to be applied. In order to obtain a very regular current of that gas, the author advises to mix the pulverised sulphide with about one-third of its weight of quartz sand or powdered sandstone. The addition of this material, in the same proportion, to black oxide of manganese, when used along with hydrochloric acid, for the disengagement of chlorine, has the effect of rendering the evolution of that gas steady while, in both cases, heat may be freely applied to the retorts or flasks without fear of breaking them.

Revue des Cours Scientifiques de la France et de l'Etranger April 23, 1870.

This number does not contain any original papers relating to chemistry or physical sciences, but we notice—

Organisation of Universities.—Dr. Du Bois-Reymond.—A valuable contribution, setting forth what universities ought to be, and how the different systems adopted in France and Germany work for or against the advantage of the students.

Asphyxia by Carbonic Vapours.—Dr. Claude Bernard.—An interesting paper in a chemico-legal as well as physiological respect.

April 30, 1870.

This number does not contain any papers relating to chemistry or physical sciences.

Bulletin Mensuel de la Société Chimique de Paris, March, 1870.

From the *procés-verbaux* of the meetings of this Society, published in this number, we abstract the following:—

M. Fleury stated that he has obtained, from the white-coloured mushroom known as *Boletus laricis*, two peculiar substances, extracted by means of ether. One of these materials is a brown-coloured resin, insoluble in water, very readily soluble in ether, less so in alcohol of 70 per cent, but very soluble in pure methylic alcohol and chloroform, and insoluble in benzol and sulphide of carbon; this resin is not crystallisable, fuses at 80°, and is soluble in alkalies, from which solution it is precipitated by alcohol; it contains $C_{41}H_{68}O_{10}$, and its barium combination is $C_{41}H_{68}BaO_{11}$. The other substance, called agaricic acid, $C_{16}H_{28}O_6$, fuses at 145°7, is readily soluble in strong alcohol less so in ether and acetic acid, and very difficultly soluble in water, to which, however, it imparts an acid reaction, perceptible by means of test-paper; this acid forms, with bases, salts; the silver salt is decomposed at 100°.

M. Berthelot communicated some of his researches on the oxidation of acetylen and allylen. The oxidising material employed is pure chromic acid free from any sulphuric acid. The energy of the action depends upon the degree of concentration of the chromic acid solution; if that solution is concentrated, formic and carbonic acids are chiefly formed from acetylen; but, if care be taken to cool down the mixture, acetic acid is formed, along with a small quantity of phenaconic acid. Allylen yields propionic acid, and, moreover, a compound containing $C_6H_4O_8$.

The following original papers are published in this number:—

New Method of Preparing Bromhydric Acid.—Drs. Champion and Pellet.—The authors first state that they tested two samples of bromhydric acid as now met with in commerce. The sp. gr. of one of these samples was 1·3, and it contained 0·3 grm. of real acid to the c.c.; the other sample had a sp. gr. of 1·12, and was found to contain 0·25 grm. of real acid to the c.c. The process proposed by the authors for the preparation of pure bromhydric acid by a rapid and safe process, is based upon the mutual reaction of the vapours of bromine and paraffin, as already quoted by us from the *Comptes Rendus* (see Chemical News, vol. xxi., p. 154).

Composition of Fossil Bones.—A. Scheurer-Kestner.—This rather lengthy paper contains the results of the author's researches, not simply on the composition of fossil bones, but also on the influence the soil in which they are found may have had in determining their more or less complete petrification. The soil (*lehm*, a kind of marl) in which the bones referred to were found was composed, in 100 parts

of—Hygroscopic water, 1·83; water driven off at red heat, 6·91; carbonate of lime, 28·19; carbonate of magnesia, 1·86; oxides of iron and alumina, 7·0; silica, 53·74; chloride of calcium, 0·31; sulphuric acid, 0·16. The paper contains a lengthy series of different analyses of fossil bones, as well as of bones, chiefly human, buried for centuries. The author states that his researches prove the fact that both these kinds of bones have undergone a similar alteration, because they both contain an organic matter, termed osseine, which is insoluble in water, and, in addition thereto, another nitrogenous organic matter, derived from the last-named and soluble in water. The slow decomposition which bones undergo depends upon the physical conditions, as well as the chemical composition, of the soil wherein they are deposited; but, as regards bones met with in the same geological formation, and buried together, chemical analysis, as proved by the author, can ascertain the age of such bones.

Preliminary Notice on a New Pigment met with in Bile.—E. Ritter.—The author states that he has obtained, from bile, a blue-coloured material, insoluble in chloroform and acids. Its alkaline solution is colourless, or yellowish; it is a substance which resembles indigo to some extent, but differs from it by the fact that its alkalino-glucosic solution, after having been neutralised with an acid, deposits, on being exposed to air, a brown-coloured compound, which does not become blue again until after some length of time, whereas indigo, under the same conditions, re-assumes its blue colour directly. This blue pigment is obtained from bile after first filtering it, and next shaking it with chloroform. The solution thus obtained is next treated with a very weak solution of caustic soda; and, after having been neutralised with hydrochloric acid, applied in slight excess, the acid solution will contain the blue matter in state of suspension.

Heat Disengaged by the Combination of Boron and Silicium with Chlorine and Oxygen.—L. Troost and P. Hautefeuille.—This very lengthy essay is divided into the following chapters:—Heat disengaged during the combination of boron with chlorine and oxygen; heat disengaged during the combination of silicium with chlorine and oxygen; applications to metallurgy.

Iodo-Mercurate of Copper.—Drs. Willm and Caventon.—The material alluded to, which appears to contain $HgCu_2I_4$, behaves as if it were composed of $HgI_2.(Cu_2)I_2$; its colour is vermillion at the ordinary temperature, but brown at 100°. When this compound is boiled with ammonia, a portion of the mercury separates. This iodo-mercurate of copper is produced by the action of iodo-mercurate of potassium upon sulphate of copper.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, 1870.

This number contains the following original papers and memoirs:—

By-Products Accompanying the Preparation of Chloral on the Large Scale.—G. Kraemer.—The author has fully investigated the by-products just alluded to, and describes, in a lengthy paper, the following substances:—Chlorinated chlorethylen-chlorethyliden; ethylen-dichloride; chlorinated ethylen-dichloride; double (*zweifach*) chlorinated ethylen.

New Method of Formation of Collidine.—G. Kraemer.—Collidine is an alkaloid found in the products of the dry distillation of animal substances, and some kinds of coal and bituminous scales; it is isomeric with ethyl-phenylamine, ethyl-picoline, and other bodies. The author, in this paper, describes, at length, a mode of preparation of this substance from chlorethyliden and chlorethyl, by means of an alcoholic solution of ammonia, and enclosing these substances in sealed tubes kept at a temperature of 160°. After a process of rectification and purification, the author obtained the body above named, $C_8H_{11}N$, and enters into a very lengthy theoretical discussion about its formation in this instance.

On Substituted Melamines.—Dr. A. W. Hofmann.—It is not easy to give any useful abstract of this valuable paper with due regard to its intrinsic merits and the high standing of the eminent author.

Bodies Isomeric with Cyanuric Ether.—Dr. A. W. Hofmann and O. Olshausen.—This very lengthy essay is divided into the following sections:—Experiments in the methyl series, cyanuric methyl-ether; dimethyl-ether of amido-cyanuric acid; experiments in the ethyl series; diethyl-ether of amido-cyanuric acid; ethyl ether of diamido-cyanuric acid; experiments in the amyl series; experiments in the phenyl series.

Phosphates of Thallium, and their Isomorphism with other Phosphates.—C. Rammelsberg.—This paper is chiefly an essay on the crystallography of the salts alluded to.

On Bryonicine.—L. de Koninck and P. C. Marquart.—After briefly alluding to the older researches on the constituents of the tubers of the *Bryonia dioica*, a poisonous plant growing wild in Central Europe, the authors state that they obtained the body, named by them, bryonicine, from the well-known Dr. Marquart's chemical factory, at Bonn, where this bryonicine had been obtained as a by-product of bryonine. Bryonicine is a neutral substance, exhibiting crystalline structure; its colour is feebly yellow; it is insoluble in cold water, solution of caustic potassa, ammonia, and dilute mineral acids. Boiling water and boiling concentrated hydrochloric acid dissolve a small quantity of bryonicine, but, on the cooling of these fluids, it separates again; alcohol, ether, chloroform, benzol, sulphide of carbon, glacial acetic acid, and concentrated sulphuric acid dissolve bryonicine very readily. The solution of bryonicine in concentrated sulphuric acid is blood-red coloured; water precipitates the solutions of this body in acetic and sulphuric acids; its alcoholic solution is not precipitated by tannine, nor, also, by the neutral and basic solutions of acetate of lead. Bryonicine fuses at 56°, and sublimes at a higher temperature without decomposition. It is not a glucoside; its formula is $C_{10}H_7NO_3$.

On Poly-Bromides and Tetrammonium Bases.—P. C. Marquart.

Newly-Contrived Suction Apparatus and a New Alkali Apparatus.—L. de Koninck.

Contribution to the History of Napthylamine.—M. Ballo.

Action of Zinc Dust on Nitro-Naphthaline.—W. H. Doer.—Among the products of the action of finely-pulverised zinc, the author found azonaphthaline—

$$\begin{matrix} C_{10}H_7N \\ \| \\ C_{10}H_7N \end{matrix}$$

which is formed according to the following formulæ:—

$$2(C_{10}H_7NO_2)+4Zn=\left\{\begin{matrix} C_{10}H_7N \\ \| \\ C_{10}H_7N \end{matrix}\right\}+4ZnO.$$

Some of the Colouring Matters contained in Madder.—F Rochleder.—Reserved for full translation.

Account of the Electrolysis of some Chemical Compounds. N. Bunge.—Illustrated with woodcuts.

Researches on the Derivatives from Glycerine.—L. Henry.—This lengthy paper is so filled with formulæ, some of them occupying about half a page, that it is quite impossible to make any useful abstract of it.

Schiel's Chloral-Uric Acid.—N. Lubavin.—A critical review of Schiel's labours on this subject.

Action of Sodium on Acetic Ether.—A. Ladenberg.

Bicarbonate of Ammonium in the Coal-Gas at Munich.—Dr. A. Vogel.—The author states that, as far back as the year 1852, he had discovered the presence of bicarbonate of ammonium in coal-gas, and also detected, in the crystals of that substance, traces of iodine and sulpho-cyanogen. The discovery, therefore, made by Dr. Rudorff, on this subject, at Berlin, last winter, is not new; and a paper on this matter was read by the author at one of the meetings of the Royal Academy of Sciences at Munich.

This number contains lengthy reports from the correspondents of this Society at Prague, Cambridge (U.S.), Lund (Sweden), Paris, and London; but we do not give any abstracts from these reports, as our readers are already acquainted with most of them, by our abstracts from the *Comptes Rendus* and other papers.

Les Mondes, April 28, 1870.

Improved Method for the Preservation of Eggs.—S. Martin.—The author reviews, first, the various methods now in use for the proper preservation of eggs for any length of time, and discusses the value of these methods; and, further, proposes the use of collodion as a fit varnish by means of which the cause of the decay of the eggs—viz., the porosity of the shell, and, hence, access of air to the interior, may be prevented. The author also mentions that the soundness of eggs may be tested by immersing them in water containing 30 per cent of common salt in solution; in this brine, good and sound eggs sink while bad eggs float. Lastly, the author makes the very important statement, that a chemist (not specified or named) has just discovered a process whereby the albumin of the blood of butchered animals may be obtained in completely colourless state, so as to render it a fit substitute for the very large quantity of dried albumin from eggs now employed, especially in calico printing. It is a pity that this statement is not more explicitly made, and the method described.

Economical Production of Petroleum Gas, and on a Newly-Contrived Retort for its Production.—F. Boital.—The author describes, at length, and elucidates by means of woodcuts, his process for the manufacture of illuminating gas from the residues of petroleum distillation. It appears that this mode of gas manufacture is rapidly extending on the Continent. The expense of establishing works for this purpose is very much less than for coal gas; and, moreover, the gas obtained is free from ammoniacal and sulphurous products.

New Method of Hanging Bells in Towers and Church Steeples.—Rev. Equillon.—By this plan, the strain occasioned by the oscillation of the bells while being rung is entirely thrown off the walls or supports of the structure in which they are placed, by the adoption of a method of hanging described by the author and illustrated by diagrams.

Rotatory Skeleton Pump.—E. Ganneron.—A peculiar contrivance, elucidated with a woodcut.

New Work on Analytical Chemistry.—The excellent editor of *Les Mondes* highly eulogises the great merits of the second edition of "Précis d'Analyse Chimique Qualitative," par Gustave Chancel, Ph.D., &c., Doyen de la Faculté des Sciences de Montpellier. This work is very highly appreciated wherever, on the Continent, French is read, and is one of the best books of its kind.

May 5, 1870.

This number does not contain any original papers or communications relating to chemistry or collateral sciences.

Cosmos, April 30, 1870.

Geology of the Soil which had been Gradually Deposited on, and Covered over, the now recovered Ancient Amphitheatre at Paris.—Dr. Virlet d'Aoust.—A curious and interesting contribution to the daily, but permanently, occurring changes of the surface of our globe, even in inhabited localities.

Has the Sea (Mediterranean) ever been quite Close to Aigues-Mortes?—Dr. L'Hôte.—Many of our readers have, perhaps, while visiting the south of France, paid a visit to that curious remnant of the middle ages, and celebrated small town in the history of the Crusades, named Aigues-Mortes (Dépertement du Gard). At present there is a distance of several kilometres between the walls of that town and the shores of the Mediterranean. The assertion has very generally been made, that the land now existing between the town and the sea has been gradually formed since the time St. Louis, King of France, embarked at Aigues-Mortes for the conquest of Palestine, in the 13th century. The author's researches, and the discovery of stone-made structures on the land alluded to, which are proved to be of undoubtedly older date than the town itself, taken in connection with the fact that there also exists ancient documentary evidence, of undisputed authority, of the existence of a deep harbour leading from the town to the sea, entirely disprove the old assertion, above alluded to; while, moreover, as additional evidence on this point, the fact is brought forward that the littoral of nearly all the departments of France bordering on the Mediterranean presents similar features, to a greater or less extent, the same as those met with between Aigues-Mortes and the sea.

NOTES AND QUERIES.

Soap Making.—I am informed that soap makers prefer tallow to stearic acid for soap making, and that fire-rendered tallow is preferred to steam-rendered. I have looked through the works of Muspratt, Watts, Ure, and others, but can find no notice of these things; will any of your practical readers oblige by stating if such is the case, and if so, explain the reasons for it?—SAPO.

Water Analysis.—(Reply to "H. O.")—For a simple practical method, see Fresenius's "Quantitative Analysis," p. 273, new edition. No mention is made of the estimation of organic matter, as this branch is in so unsatisfactory a condition. The total organic matter cannot be nicely estimated, even if it is worth estimating; and as to that portion which is injurious, our knowledge simply amounts to a guess that it contains nitrogen.—A. V.

Water Analysis and Wood-Paper.—My attention has just been called to your Query column, "H. O." and "A. B. C." being desirous of obtaining information relative to my investigations on water analysis and wood paper. "H. O." will find the process for water in CHEMICAL NEWS, vol. xii., p. 87, signed "R. C. M." I understand that it is now employed in several laboratories. As is mentioned in the paper, the advantages of the process are the solubility of the chlorides alone in alcohol, the solution of the sulphates in water, and the carbonates, &c., in acid. "A. B. C." is desired to communicate.—R. CARTER MOFFAT.

Gas Furnace.—(Answer to "B. C. J.")—I have used Griffin's combustion furnace for some time past, and find it very convenient. The gas is burnt at a row of Bunsen's, and the tube is packed in movable fire-clay bricks with "zig-zag" edges. To prevent the direct action of the flames on the bottom of the tube, I usually rest it on a bed of asbestos contained in a narrow sheet-iron trough. The furnace is fully described in Griffin's "Chemical Handicraft" (p. 103)—A. V.

Valuation of Gas Coal.—Can you give me any information on the subject of the valuation of coal (Cannel), more particularly with reference to the estimation of the available gas. The subject is one not treated in works on analysis, so far as I am aware. Can a method of distillation in an atmosphere of CO_2 be adopted, washing the gas evolved by solution of potassa, and measuring over water, as in nitrogen determinations? The difficulty I apprehend will be that the distillation of the coal will be irregular, the amount of the gas being greater, and the tar oils less, according as the heat is quickly or slowly applied. I have made a few experiments as above, and my results do not accord, which I attribute to the irregular distillation. Is this likely to be the cause?—P. H.

MEETINGS FOR THE WEEK.

MONDAY, 16th.—London Institution, 4.
TUESDAY, 17th.—Institution of Civil Engineers, 8.
—— Royal Institution, 3. Prof. Blackie, "Principles of Moral Philosophy."
WEDNESDAY, 18th.—Society of Arts, 8.
—— Pharmaceutical, 8. Anniversary Meeting, 11 a.m.
THURSDAY, 19th.—Royal, 8.30.
—— Zoological, 4.
—— Royal Institution, 3. Prof. Tyndall, "On Electricity."
—— Chemical, 8. W. H. Perkin, F.R.S., "On Some Derivatives of Coumarine."
FRIDAY, 20th.—Royal Institution, 8. Prof. Williamson, "On Atoms."
SATURDAY, 21st.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

CHEMISTRY CHAIR IN ANDERSON'S UNIVERSITY.

TO THE TRUSTEES AND MANAGERS.

Gentlemen,—As a Professor to fill the present vacant Chair of Chemistry in Anderson's University is likely soon to be appointed, and as it is my intention to become a Candidate, I take the liberty of addressing a few statements to you as preliminary to sending in testimonials, &c.

I at present hold the appointments of Lecturer on Chemistry to the Glasgow Mechanics' Institution and Professor of Chemistry in the Glasgow Veterinary College. The former I received upwards of four years ago, when five candidates came forward; and the latter appointment I obtained, also four years ago, on the recommendation of the late Professor Penny, who was for many years chemical teacher in both institutions—and on his resignation of the Professorship in the Veterinary College, it was mainly through him that I was appointed in his place.

About five years ago, the Faculty of Physicians and Surgeons of this city deputed two of its members to report on my Chemical capabilities; and the result was a grant from that body recognising my lectures and practical classes as qualifying for examination before their board, and all other boards, &c., which recognise the Chemical teacher's certificates of Anderson's University.

I received my Chemical training in Edinburgh College of Surgeons, under Dr. Macadam, where I remained upwards of seven years. During much of that time I was Senior Assistant and Demonstrator, and had charge of large classes of both medical and manufacturing students. The analyses of medical and technical products were made daily by me in Dr. Macadam's laboratory.

On my coming to Glasgow to open a laboratory of my own, which I did in Ingram Street, I found the field of work extensive enough, but so well taken up by other Chemists that little could be accomplished for a year. My appointments to the Mechanics' Institution and Veterinary College, as Chemical teacher, opened a road; and by no small amount of energy and perseverance I have now the satisfaction of possessing the largest Practical Chemistry Classes in the city.

I have lectured daily, and held practical classes, in my laboratory and lecture-rooms and out of them, for five years, since I came to Glasgow. As you are already aware, I have expended large sums of money in fitting up my laboratories, &c., with apparatus suitable to the advancement of classes in Technical Chemistry.

The number of medical students who have attended my lectures and classes has been considerable, and at the present time at the Practical Medical Class there are twenty-one students. This number, when it is remembered the disadvantages the additional teacher must be under, who is some distance from the Andersonian, is highly gratifying.

It is out of place at this time to refer to personal scientific researches and discoveries; but, as indicating that I have not been backward in adding to Chemical facts, I may mention Oleography, Water Analysis, Free Sulphuric Acid, Manure Analysis, Detection of Strychnine, Blood Stains, Wood Paper, as some amongst my original investigations.

The departments of Scientific, Medical, and Technical Chemistry occupy my entire attention, and perhaps the best evidence of work done satisfactorily is in the fact of having enrolled, during three sessions, upwards of 500 practical students, and these at fees considerably higher than at any laboratory in the city; while the number of lecture students was 313. These numbers chiefly represent manufacturing students.

Should I have the honour to be elected by you, I shall endeavour to hold the appointment with acceptance.

I beg to place before you these statements, and I shall consider it a great favour to have your support at the time of the appointment.

I am, Gentlemen, yours respectfully,

R. CARTER MOFFAT, PH.D.

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THE CHEMICAL NEWS.

Vol. XXI. No. 547.

GOLD REFINING BY CHLORINE GAS.*

By F. B. MILLER, F.C.S.,
Assayer in the Sydney Branch of the Royal Mint.

There is no recorded instance of gold having been found in an absolutely pure state. Every natural alloy of gold (or native gold, as it is called by mineralogists) contains more or less silver; and in almost all bullion resulting from the melting of Australian alluvial gold, the portion that is not gold consists chiefly of silver, with only a very small proportion of foreign metals, usually copper and iron, with occasionally a little lead or antimony, and sometimes a trace of tin, iridium, &c. This, however, though true generally, is not always the case with gold obtained from quartz veins by amalgamation, as the mercury occasionally reduces and takes up other metals, as well as the gold, which appear in the bullion on melting. The accompanying table will give some idea of the proportion of the precious metals contained in the gold from the various districts of New South Wales after melting. It will be seen that the most argentiferous is that from Boonoo Boonoo, in the north, containining as much as 34 per cent of silver. This approaches, in composition, the gold from the productive Thames district of New Zealand; while the gold from Nerrigundah, in the south, only contains 1·5 per cent of silver, the remaining 98½ per cent being gold with a trace of copper.

Table showing the Proportion of Gold and Silver, in characteristic samples of Gold-Dust, from various localities in New South Wales (after melting).

	Locality.	Gold in 1000 parts.	Silver in 1000 parts.
Northern.	Boonoo Boonoo	654 to 695	337 to 298
	Fairfield	872	121
	Timbarra	708 to 898	280 to 97
	Peel River	929	67
	Rocky River	934 to 962	61 to 33
	Nundle	923 to 937	66 to 63
Western.	Bathurst	827 to 903	164 to 92
	Sofala	929 to 933	66 to 63
	Tuena	943	54
	Ophir	915	82
	Tambaroora	943 to 954	54 to 42
	Turon	918 to 928	78 to 68
	Hargraves	915	83
	Windeyer	946 to 959	53 to 37
Southern.	Burrangong	948	48
	Adelong	946 to 951	52 to 45
	Braidwood	928 to 934	67 to 62
	Emu Creek	971	27
	Delegate	971	27
	Nerigundah	983	15

An interesting, and as yet unanswered, question here arises — Is this argentiferous character in any way connected with the geological structure of the district?

It is a fact, and certainly a very curious one, whether it arises from accidental causes, or whether it may hereafter be traced to peculiarity in the rocks whence the gold of the different districts is derived, that its quality or fineness deteriorates the farther north we go; in other words, it contains more silver and less gold.

Thus, the average fineness of Victorian gold is about 23 carats—that is to say, it contains about 96 per cent of gold and 3½ of silver, with ½ a per cent of base metals; while, on passing north, we find the average fineness of New South Wales gold to be only 22 carats 1½ grain, or to contain 93½ per cent of gold and 6 per cent of silver. On going still farther north, to the colony of Queensland, the average fineness is little more than 21 carats (considerably below standard), or it contains 87½ per cent of gold and 12 per cent of silver; that from Maryborough containing as much as 14 per cent of silver and only 85 per cent of gold.

These are averages only. It is not to be supposed that there is a regular and consecutive diminution in fineness with every degree of latitude we go north. There are exceptional localities in the north of this colony, where the gold found is of a high degree of purity, as at Rocky River, where it is over 23 carats fine, or 96 per cent.

Possibly, at a future time, our geologists may be able to throw some light on these curious facts, and the exceptional cases may, then, even help in explaining the apparently general rule.

The point, however, of principal interest, as far as regards the subject of this paper, consists in the fact that, as the alloy obtained by the gold miner is poorer in gold, it is proportionally richer in silver.

According to the published returns, 6,820,198 ozs. of gold have been received for coinage in the Sydney Mint between its establishment, in May, 1855, and December 31, 1868.

The average assay of this quantity would be about 943. In other words, it contained 94½ per cent of gold, 5 per cent of silver, and ½ per cent of base metals.

Allowing an average loss of 2 per cent in melting the gold dust, there would remain, after smelting, 6,683,795 ozs. of gold bullion; and, as the silver it contained amounted to 5 per cent of this quantity, the gross amount of silver in the gold received for coinage was 334,190 ozs.; being at the rate of 24,750 ozs. per annum.

The average proportional quantity of silver contained in the gold arriving in Sydney is at present very much greater than that given above, owing to the large amount of silvery gold now being found, especially in the neighbouring colony of Queensland, and for the year 1868 was not less than 36,000 ozs. (£9150), and was probably (including that in the gold shipped direct as bullion by the banks) nearer 42,000 ozs.

Most of the silver thus naturally present in the gold has hitherto been lost to the colony, owing to the expense, in Sydney, of the acids, &c., necessary for its extraction by any of the usual methods of refining, which left little, if any, margin of profit on the operation. It therefore seemed desirable that some easy and economical process should be contrived for refining, in Australia, without the aid of costly plant and chemicals.

Twelve months ago, a paper of mine, describing a new process for refining and toughening gold by means of chlorine gas, was read before the Chemical Society, London. As, since the publication of that paper, the method of refining therein proposed has been successfully brought into practical operation on a large scale, both here and in New Zealand, and there is a probability that its adoption will, before long, become more general, I lay before the members of this Society a somewhat detailed account of the process, and some of its more striking results.

I shall, as far as possible, avoid giving the details of the preliminary experiments which lead to the practical application of the process, and which have already been published in the *Journal of the Chemical Society*;* but, in order to render myself intelligible, some repetition of what is therein contained will be necessary.

Most people at all interested in the matter are aware that the ordinary method of separating silver from natural alloys of that metal and gold is a complicated and expen-

* Read before the Royal Society of Victoria.

* See also Chemical News, vol. xviii., p. 234.

sive process, and that the end is attained by melting the gold with at least 2½ times its own weight of silver, and then again separating, by the action of acids, the silver thus added, and also, at the same time, the small quantity originally contained in the gold, thus leaving, as a residue, fine gold assaying from 990 to 993; the *rationale* of the operation being this:—If the natural alloy were simply placed in the acid, the very large excess of gold in the alloy would completely protect the silver it contained from the action of the acid; but, if the gold is melted with a large excess of silver, so that the silver greatly preponderates over the gold in the alloy treated, then the acid is able to exert its solvent action not only on the silver thus added, but also on that originally contained in the gold. To arrive at this end, a complicated and very costly plant is required, besides large quantities of expensive acids; and several days are occupied in the operation. It is evident, then, that, if all this complicated process can be avoided, and the silver simply and completely separated in one operation at the time the gold is being melted, a very great saving of time, of material, of plant, and of the interest involved in all these, will be effected.

Such an end is attained in the plan now being adopted for effecting this operation.

It is well known that chlorine readily enters into combination with almost every known metal, the action, in some cases, being so violent as to be attended with vivid combustion. Many metals, such as lead, tin, zinc, and antimony, when introduced into this gas, even at ordinary temperatures, combine with it, forming highly-volatile chlorides. The two latter, if in a state of fine division, burst into flame on being placed in an atmosphere of chlorine.

Copper also exhibits spontaneous combustion under similar circumstances, but the resulting chloride formed is only slightly volatile.

Silver, immersed in chlorine gas at ordinary temperatures slowly unites with it, forming chloride of silver; but, if the gas be passed over it while red-hot, the action is much more energetic, the compound formed being more volatile than the chloride of copper, but much less so than those of lead, tin, zinc, or antimony.

The method of refining now to be described is based upon these facts.

It consists simply in passing a current of chlorine gas through the gold *while in a melted state*, which is easily done by thrusting into the molten metal a small clay tube connected with a stoneware vessel in which chlorine is generated.

The chlorine, on coming in contact with the silver in the molten alloy, at once combines with it, forming chloride of silver, which, being of less specific gravity, rises to the surface of the melted gold, while this latter remains in a purified condition beneath.

Chloride of silver has always been considered a somewhat volatile substance, and, under circumstances such as those here described, it was naturally supposed that it would either be sublimed in the flue or escape entirely up the chimney; but, in practice, it is found that the volatility of the chloride is not nearly so great as might have been anticipated, and that, if its surface is coated with a layer of fused borax, it may be kept melted at a high temperature, without any very material loss.

The furnace required for the operation is the ordinary 12-inch square gold-melting furnace, the principal points to attend to in its construction being (1) that the flue should be as near the top as possible, so as to allow of the crucible standing high up in it without being cooled by the draught, and (2) that the furnace itself should not be too deep, so that, when the pot is placed in the fire, the bottom of it may not be more than 3 inches above the bars.

The covering of the furnace should consist of two fire-tiles, 7½ inches wide and 15 inches long, one of which should have a long slot or hole in its centre, for the clay chlorine-pipes (which I shall describe presently) to pass through. An iron cover will not answer, as it soon becomes much too hot for convenient working.

The crucibles in which the refinage is performed should be French white fluxing-pots (creusets de Paris, made by De Ruelle, late Payen, Paris); ordinary black-lead pots will not answer, owing to the reducing action they exert on the compounds formed. To prevent the infiltration of the very fluid chloride of silver into the pores of the clay pots (which would otherwise occur, and necessarily entail loss), they are prepared by filling them with a boiling saturated solution of borax in water, which is allowed to stand in them for ten minutes, and is then poured off, the crucibles being afterwards set aside to dry: the borax forms glaze on the inner surface of the crucibles when they become hot in the furnace.

When used for refining, these French clay crucibles are placed within black-lead pots, as a precaution against loss, should the former crack, which, however, seldom happens. The crucibles are covered with loosely-fitting lids, with the requisite holes bored through them for the passage of the clay chlorine-pipes, &c. Ordinary clay tobacco-pipe stems, from 17 to 22 inches long, have been found to answer well for the purpose of passing the chlorine gas through the melted gold. Of late, a pipe made in London to order, ¼ inch in diameter, 22 inches long, and 3-16-inch bore, has been found to answer all requirements. The chlorine-generators should consist of the best glazed stoneware acid-jars, capable of holding from 10 to 15 gallons, and furnished with two necks. One of these openings should be stopped with a sound cork (or vulcanised india-rubber plug, if obtainable), through which should pass tightly two glass tubes, the eduction-tube and the safety or pressure tube, the length of the former being a few inches, and the latter 8 or 10 feet, spliced, where necessary, by means of vulcanised india-rubber tubing. The other opening, intended for introducing the oxide of manganese, &c., should be closed with a leaden plug, covered with a short piece of india-rubber tube by way of a washer, and well secured.

Each generator should be charged with a draining-layer of small quartz-pebbles, down nearly to the bottom of which the pressure-tube should extend. On this layer should be placed from 70 to 100 lbs. weight of binoxide of manganese, in grains about ¼-inch cube, sifted from powder; this quantity will be sufficient to effect many refining operations, and will obviate the necessity of repeated dismantling of the apparatus.

Each generator should be suspended to about half its height in a galvanised-iron water-bath.

The chlorine gas is produced, when required, by pouring common hydrochloric acid (sp. gr., 1·15) down the safety-tube, the apparatus being warmed by means of gas-burners beneath the water-baths. The gas is conveyed from the generators by means of a leaden pipe fitted with branches to supply the several furnaces, all intermediate connections being formed by means of vulcanised india-rubber tubing, which, if screened from the direct radiation from the fire, stands the heat well, even immediately over the furnaces. All joints between the various pipes and india-rubber tubes are easily secured, and rendered perfectly gas-tight, with a cement consisting of a thin solution of india-rubber in chloroform.

Screw compression-clamps on the india-rubber tubes give the means of regulating the supply of gas as required, and enable the operator to shut it off entirely as soon as the refining is over. The chlorine then, having no means of escape, accumulates in the generator, and soon forces all the acid up the safety-tube into a vessel placed above to receive it, and, the acid no longer acting on the oxide of manganese, the supply of gas of course ceases.

These generators are very convenient and manageable, and it is questionable whether a gas-holder for the chlorine (even if the practical difficulties in its use could be overcome) would be at all preferable. Two such generators

as are here described, and three ordinary gold-melting furnaces, have been found capable of refining daily about 2000 ounces of gold containing about 10 per cent of silver, between 9 a.m. and 2 p.m.

(To be continued.)

ON WHEAT AND WHEATEN BREAD.

By M. H. MEGE-MOURIES.

It will be remembered that, since 1855, my studies respecting the chemical action of organic tissues have been applied to the important subject of bread, and that the following facts have been ascertained:—1. That brown bread contains colouring matter, lactic acid, glucose, dextrine, &c., proceeding from the alteration of one part of the flour; 2. That not one of these products existed previously in the grain; 3. That they are formed by the complex action of a leaven which I call cerealine; 4. That, by suppressing the action of this ferment, brown bread ceases to be formed, and a white bread only is produced, superior to the ordinary kind.

Conformably with these observations, I brought into practice a process founded on the property possessed by yeast of transforming cerealine into yeast when added to a liquid in full alcoholic fermentation. This process was approved of by the Academy (Report of M. Chevreul, Jan. 12th, 1857). In England and Germany, inspired by the facts previously indicated, the end was reached in a more direct way, replacing all kinds of fermentation by introducing carbonic-acid gas, or by setting it free in the dough itself by bicarbonate of soda and chlorhydric acid. In Paris, the process approved by the Academy is not completely brought into practice: custom demanded that it should be modified so as to retain the leaven of dough, despite its drawbacks. Among the most intelligent and important advocates of the new mode, with a leaven of dough, may be reckoned the city of Paris, which furnishes the public charities and workmen of Paris with 25,000 kilogrammes per diem of bread, very superior to that of the common bakers.

I am permitted by the Academy, in the interest of the public, to give a short extract from a remarkable statement made to the Prefect of the Seine by M. Husson touching some ameliorations made during his administration from 1852 to 1869. The statement says, at page 14:—"One of the most interesting uses to which the Scipion works have been applied is that of carrying out the Mège-Mouriès process." And, further on, it continues:—"This process has been entirely adopted throughout the manufactory for four years, without alteration in the colour of the bread; and the results were highly satisfactory, although still beneath what was expected of it. The profit arising from this mode of panification is a little over 1 centime per kilogramme; besides which, the brown bread formerly consumed in the large almshouses is now replaced by white bread exactly similar to that supplied to the others by the manufactory. These results are doubtless satisfactory; but they do not at all agree with those noticed in the reports of M. Chevreul, of the Minister of War, and of General Favé, reporter for a commission of practical men chosen by the Minister of Commerce, and which included the late lamented M. Salone, formerly Manager of the Scipion Works."*

Notwithstanding my gratitude towards the Director of Public Charities, it is as well to state the reason of these discrepancies for the sake of common manufacture, and for those co-operative societies which may feel inclined to follow the good example of Scipion.

1. The Commission has always put to profit the curious property of the embryo tissue of not allowing salted water to penetrate the interior of the grain—a property which renders the elastic outer integuments capable of closer grinding and a larger yield.*

2. It must not be forgotten that, before the application of the new process, hard or semi-hard wheat was used at Scipion; and, as the yield from this is much greater than that arising from young wheat, the comparative figures cannot be exact.

3. By giving the aged inhabitants of almshouses white bread instead of brown, they, in fact, receive more bread, as brown always contains more water than white. This is an advantage, and it should be reckoned.

4. The Commission, in common with the general practice, have never admitted that it was possible, by the ordinary process, to make superior bread with flour obtained above the rate of 70 per cent; and it is from this figure that the economic difference is inferred. The discrepancy is obviously only apparent. Here is the process:—

The corn is moistened with from 2 to 5 per cent of water saturated with sea-salt; and, at the end of some hours, the exterior coverings only become moist and tender. The grain is then thrown between nearly-closed millstones; and 70 per cent of flour is obtained without cerealine, plus 10 to 14 per cent of meal. This is bruised between light stones, and separated, by winnowing, from the greater part of the husk remnants.†

To prepare the bread, all the leaven is made with the flour at 70 p.c., and the meal is added to the soft dough last of all; as, in spite of the small amount of cerealine which it still contains, it will not produce brown bread, because, at that time, the length of incubation is not sufficient to change it into a leaven. Thus white bread is produced containing all the farinaceous part of the wheat (80 to 82 per cent).

Laudable efforts (pursuant of my advice) were made at Scipion to mingle the flour with the meal, which would be quite practicable could machines be obtained which would remove all fragments of outer integuments from the meal.—*Comptes Rendus.*

* *Moniteur Universel*, 1869.

LUMINOUS FOUNTAINS.‡

By Prof. H. MORTON, Ph.D.

We believe that this experiment was first performed by Duboscq, and, though often repeated, and frequently alluded to in various publications, is generally regarded as presenting great difficulties in its re-production. Our own experience has, however, shown us that it may not only be repeated, with little cost and great ease, by anyone having the usual appliances of a gas-lantern, but that it is an illustration of great beauty and interest, which would amply repay many times the trouble of its development.

Success, however, depends upon attention to a few particulars, which, to the best of our knowledge, have never been put on record, and we will therefore proceed to give a full description of the same.

Desiring to arrange this illustration, and hearing that Mr. E. S. Ritchie, of Boston, had made very thorough and successful investigations as to its best adjustment, we wrote to him for information, and were furnished by him, in the most liberal and amiable manner, with full accounts of all essentials, by reason of which we had nothing to do but to put together a few parts as described, in order to secure at once complete success.

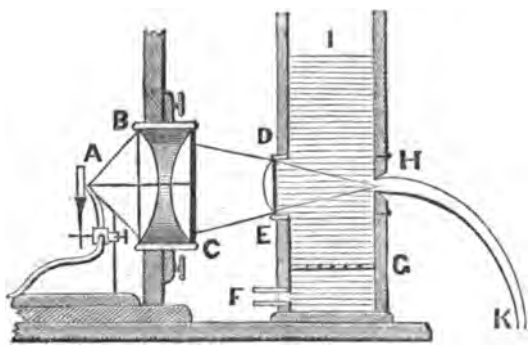
The important points, as described by Mr. Ritchie, and verified in our own experience, are these:—1. Avoidance of currents and commotion in the reservoir; 2. the employment of a sharpe-edged diaphragm, very smoothly finished, as a jet.

* *Memoire de la Societé Imperiale et Centrale d'Agriculture*, 1860.
† At Scipion, the Perigault winnower was used.
‡ Communicated by the Author.

The entire arrangement of parts is as follows:—

Let A represent the line light in the lantern-box, and B E the condensers attached to its front, the object-glass, tube, &c., being removed. By this means a cone of light is projected upon D E, which represents a plano-convex lens, of 3 to 4 inches diameter, and 6 to 7 inches focal length. This lens fits into a cell, against a ring of rubber,

Fig. 1.



upon which it is pressed by a screw-cap, so as to render the joint water-tight. The tank, P G, is made of wood or tin, about 18 inches in height, 5 or 6 inches in the direction D H, and about 1 foot transversely.

At H is attached a diaphragm, opening, or outlet, flush inside with the front of the tank, sharp-edged, and bevelling outwards. Near the bottom of the tank is a perforated shelf or false bottom, E G, below which enters the inlet-pipe, F. The shelf, E G, serves to distribute the inflowing water, and prevent violent currents.

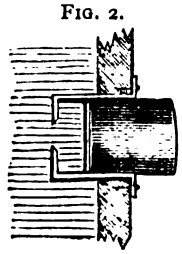
Under these circumstances, the water-supply, being carried to F by a ¾-inch rubber hose from a hydrant or like supply, is regulated so as to keep a steady level at I (which can be easily recognised by watching the point of contact of the jet, H K, with the basin or reservoir in which it is received), and the light is turned on in the lantern.

We then have the light from the condensers concentrated at H, and thence issuing with the vein of escaping water, from whose interior surface it is repeatedly reflected so as to follow down the entire length of the jet, which thus becomes brilliantly luminous, appearing as a stream of liquid light or luminous water.

If the jet is then received in a large glass goblet or vase, this, also, as well as the drops and streams running over and from it, will gleam and glimmer in a beautiful manner. By placing a piece of coloured glass in front of the condensers, B C, the stream of light will be converted into a jet of liquid rubies, emeralds, or sapphires, according to the colour employed.

If the supply is taken from an ordinary hydrant, the outlet, H, should not be more than 0·5 inch in diameter.

Fig. 2.



In starting and stopping, it is often desirable to close the outlet, H. To do this with a cork directly applied is at once awkward, and likely to injure the smoothness of the edge, which is so important to success. To obviate this difficulty, we have long used the following plan:—Let the diaphragm be attached to the end of a short tube, running a little way into the tank, or projecting from it. A cork may then be used to close the outer end of this with ease, and without risk to the diaphragm.

In the experiments which we have made thus far, we have only employed jets of ¼ inch in diameter, and making streams of 7 to 8 feet in height; but Mr. Ritchie, in some experiments made at Boston, with a view of public exhibition on the evening of July 4th, produced successfully jets of 15 to 20 feet, and 1¼ inches in diameter, illuminating them with an electric light from 100 large Bunsen cells.

With regard to the arrangements used for this purpose, Mr. Ritchie tells me that he carried the water from the street-pipe by fire-engine hose, first to a barrel (which, being air-tight, served as an air-chamber), thence to a long, erect, conical vessel, having five horizontal partitions, pierced with numerous small holes to distribute the flow and avoid strong currents. The side of this vessel, in which the outlet was placed, was flat, and in this the sharp-edged opening was fixed. The experiment with these arrangements proved perfectly successful, and was exceedingly beautiful if the air was calm; but the least wind ruffled the jet, and spoiled the effect. Prof. Pepper, as appears in his "Play Book of Science," conducted, with great success, similar experiments in the Sydenham Crystal Palace; but, in his description, he omits to mention those points which are, as we find, essential to success.

In another form, a less theoretically, but more obviously beautiful, illuminated fountain may be arranged as follows, the description being taken from one which I arranged in one of my lectures, during the winter of 1868, at the Franklin Institute.

On a light table, about 3 feet 6 inches in height, is placed a shallow basin or pan of tin, 6 feet in diameter and about 2½ inches deep, supported by a skeleton framing of wood. Around the edge of this basin is placed a ring of ¾-inch lead pipe, provided with fifty vertical jets, each of $\frac{1}{32}$ inch aperture, turned slightly inward. Towards the centre is a ring of similar pipe, 18 inches in diameter, also provided with fifty similar vertical jets, inclined slightly outwards. Both pipes are connected with the water-supply, but controlled by separate stop-cocks.

When operating together, they form a beautiful pyramidal sheaf of spray (in the case just mentioned) 15 feet high and 6 feet in diameter at the base. The jets are each attached by a short piece of ¼-inch lead tube, which allows of their ready adjustment in direction.

So much for the fountain. We next come to the arrangements for illumination.

On the lower part of the table-frame which supports the basin is arranged an ordinary magic-lantern with its condensers in its roof, protected by an inclined plate of glass, directing the ascending stream of heated gases to a crooked chimney of 1¼-inch tin pipe. Immediately above these condensers is an opening through the basin, with a high margin to it, on top of which fits a cap carrying a plano-convex lens of about 7-inch focus, placed with its plano side uppermost, and fitted water-tight in a cell with a deep rim. This cell being then filled with water, we get rid of the otherwise serious effect from a misplaced drop of spray on the glass: such an accident now only causes an instant's disturbance to the action of the lens, but otherwise would greatly modify its action, if lying as a bead upon it.

This lens is so adjusted, with regard to focal length and position, as to make on the ceiling, about 16 feet from the tank, a circle of light 3 feet in diameter. To the ceiling, at this place, is attached a plain mirror, which, then reflects the incident light at the same angle, so making a truncated cone, 3 feet at top and 6 feet at base, which just takes in the entire sheaf of jets.

This arrangement alone gives a very beautiful effect; but, further to increase the illustration, I had a hole cut through the ceiling, from the floor above, just outside of

the mirror, and through this directed a cone of light from a lantern with its nose turned downwards.

By using parti-coloured figures of gelatine simultaneously in the two lanterns, the effect was beautiful beyond description, a veritable fountain of various scintillating jewels being produced. By adjusting and turning on the light first, and afterwards the water, this last seemed to be the veritable source of the illumination. The light without the water-jets was scarcely appreciable to anyone not close to the tank, while the moment the fountain was turned on the whole room was lit up. The most pleasing effect of all was obtained by making glass circles with six segments of different colours, and rotating these slowly in the upper lantern, the changing prismatic tints of the various sprays being something that literally "must be seen to be appreciated."

ON THE

ABSORPTIVE POWER OF SOIL.*

By ROBERT WARINGTON, F.C.S.

(Concluded from p. 223.)

HAVING thus described the results obtained in the College Laboratory, we will now attempt to point out those conclusions with regard to the phenomena of soil absorption which the accumulated facts of the case seem to warrant.

The question which chiefly demands attention is the nature of soil absorption. Is it a physical or chemical action, and by what ingredients of the soil is it exerted? In order to form a definite notion concerning the first part of this question, let us, in the first place, inquire, What is physical attraction? We will take the decolourising power of charcoal as an example of this action.

Liebig tells us, and we believe rightly, that the attraction of the charcoal for the particles of colour is quite similar to the attraction by which these particles were previously dissolved and held in solution by water. "If the attraction of the charcoal is somewhat greater than that of the water, then the colouring-matter is completely withdrawn from the water; if the attraction of both is equal, a division takes place, and the extraction is only partial."† Liebig, however, characterises this power of charcoal as *chemical*:—"This power in charcoal depends upon a chemical attraction proceeding from its surface"‡. Other chemists affirm, on the contrary, that the attraction of both charcoal and water is simply a case of physical adhesion; the same action by which a stick dipped in water comes out wetted. Against the chemical hypothesis it may be urged with force, that, to use Liebig's own words, "the materials attracted by the charcoal retain all their chemical properties;" so that on this view we really have chemical action taking place without any chemical change resulting. In support of the second hypothesis it may be be observed, that charcoal appears to attract chiefly those substances which are sparingly soluble in water; those, in fact, for which water has a small adhesive power, that may with comparative ease be overcome.‖

Assuming, then, as most probable, that the action of charcoal and other similar absorbents is owing to the physical attraction of adhesion, we have next to ask, Is this physical attraction exerted by soil, and can the absorptive properties of soil be thus explained?

It seems very probable that physical attraction is exercised by soil, and that the clarifying action of clay, and of soils generally, when brought in contact with sewage and similar solutions, is mainly owing to an absorbent action very similar to that exerted by charcoal under the same circumstances. But this physical action of soil we believe to have little or nothing to do with the absorption of ammonia, potash, phosphoric acid, and generally of those salts which form an important part of plant-food. Charcoal appears to be quite incapable of removing ammonia from solution, and it seems, indeed, unlikely that so soluble a substance should be removed from solution by the force of adhesion of any solid body. The same may be said of many other soluble salts readily taken up by soil, but unaffected by charcoal. The probability of the action of soil in these cases being due to physical attraction is therefore very small. On the other hand, we have considerable evidence of chemical action in the absorption of many substances by soil; the evidence is, perhaps, strongest in the case of phosphoric acid.

It is now allowed by most agricultural chemists that the hydrated ferric oxide and alumina of soil unite with the phosphoric acid applied in manure, and form basic phosphates of iron and aluminium. We have already described some experiments which appear satisfactorily to establish this reaction between soil and phosphoric acid. E. Peters has also recently published a research upon the same subject.* He endeavoured to ascertain the state in which phosphoric acid was held in soil, by acting on a soil, recently manured with bone dust, with different solvents. He came to the conclusion, "that the phosphoric acid in soils is almost entirely combined with ferric oxide and alumina;" and "that from a solution of phosphate of calcium in carbonic acid, phosphoric acid is taken up by soils only when the latter contain compounds of alumina or ferric oxide; soils deprived of these compounds by treatment with acids are indifferent to the phosphatic solution." His conclusions thus perfectly agree with those stated above; the absorption of phosphoric acid by soil is considered to be a purely chemical operation.†

If we turn to the phenomena which attend the absorption of bases from their salts, we also find considerable evidence of chemical action. The facts we refer to have been already noticed. We have seen that soil acts differently towards various salts of the same base; that the bases of phosphates and carbonates are taken up by soil in greater quantity than the bases of sulphates, chlorides, or nitrates. This preference is certainly due to the chemical relations of the various acids to the constituents of soil. The reaction between a soil and an alkaline phosphate will, after the previous discussion, be quite plain to us; the acid of the salt will be appropriated by the ferric oxide or alumina, and the base be thus left in the form of hydrate, the form most favourable to combination. Carbonates are known to all chemists as salts that are easily decomposed, even by bodies of feeble acid properties; the ready absorption of bases from their carbonates might therefore naturally be expected. The carbonic acid liberated probably combines, in most cases, with the lime of the soil. In one of Way's experiments, in which a solution of carbonate of ammonium had been poured upon soil, bicarbonate of calcium was found in the water which drained through. Sulphates, chlorides, and nitrates are not taken up by soil to any appreciable extent unless the soil already contains lime, magnesia, or soda; or, to speak more accurately, some base for which the absorbing ingredients have a smaller affinity than they have for the base of the salt presented to them. In the majority of cases lime is the active base in these reactions, and the acids of the salts are found combined with lime in the drainage water from the soil. Way showed in the case of a chloride, and Voelcker in the case

* *Practice with Science*, vol. ii.
† "The Natural Laws of Husbandry," p. 66.
‡ *Ibid.* p. 65.
‖ For some excellent observations on the subject, see Miller's "Chemistry," vol. i., pp. 73—75.

* *Annalen der Landwirthschaft*, 1867, p. 31.
† When a solution of superphosphate is applied to soil, the phosphoric acid is probably in the first instance precipitated by the lime of the soil; the action of the ferric oxide is in this case subsequent and gradual.

of a chloride and nitrate, that none of the acid of the salt was absorbed by the soil. The salts had been decomposed by the lime of the soil, and their bases only had been removed from solution.*

Facts, in short, show very clearly, that when the solution of a salt is brought in contact with soil, the salt is always decomposed if absorption takes place; this decomposition is, of course, clear evidence of chemical action. We have been able to give a tolerably satisfactory account of all these reactions as far as the acids of these salts are concerned. We are not able to account so certainly for the bases; they are absorbed by the soil: but with which of the ingredients of the soil do they combine? We cannot trace their course in the reaction, and are obliged to resort to secondary evidence.

We have already mentioned two classes of bodies which experiment has shown capable of removing bases from the solutions of their salts; these are the hydrated double silicates, and the hydrated oxides of iron and aluminium. Now, if these compounds can be proved to exist in soil we are certainly warranted in including that the absorption of bases by soil is due to a greater or less extent to their influence.

There is no doubt whatever as to the occurrence of hydrated ferric oxide in soils; it is probably a universal ingredient of soil, and is often present in very considerable amount. The occurrence of hydrated alumina in soils is doubted by some chemists; it is, in fact, difficult to tell to what extent the alumina found in soil is combined with silica, and to what extent it exists merely as hydrate. The question does not, however, materially affect our argument, as we have seen that ferric oxide is apparently a far more efficient absorbent of bases than alumina. We may consider it, therefore, as established, that the ferric oxide present in soils plays a part in the absorbent action of soil towards bases, and that the bases absorbed by soil become, in part at least, united to ferric oxide.

It is very difficult to prove the presence in soils of the particular class of double silicates which Way has shown to possess such a remarkable power of removing potash, ammonia, and other bases from solution.† That soils contain both silicates, and hydrated silicates, does not admit of doubt; in fact, silicates are often the largest constituents of soil; but that the hydrated silicates are silicates of aluminium and calcium, is more than chemical analysis has yet been able to decide. The probability that such silicates are present is, however, very great. The felspars and micas, from the disintegration of which the silicates of soil are chiefly formed, are all of them double silicates of aluminium with potassium or some other alkaline or alkaline-earthy base; that in the decomposition of these hydrated double silicates of a similar constitution should be formed, is certainly to be expected. There appears, in fact, no ground for reasonable doubt that the silicates described by Way are really present in soils, and we must, consequently, ascribe to these silicates a part in the absorbent action of soil.

There yet remains another ingredient of soil which, probably, takes some part in the absorption of bases,—this is the humus. Humus, or rather the various bodies which compose it, possesses a feeble acid character, and being insoluble in water, or nearly so, is very probably capable of forming insoluble compounds with bases. Brustlein‡ has experimented with pure humus obtained from a decaying oak. He found it to possess a considerable power of absorbing free ammonia, but with solutions of the salts of ammonium it failed to effect any absorption. Since soils and clays almost destitute of organic matter often possess high absorbent powers, the part taken by humus is probably of inferior importance.

We have, then, evidence that soil contains several ingredients that have the property of forming more or less insoluble compounds with bases, and are known to be capable of withdrawing bases from solution. Though, therefore, we are unable to trace the mode of combination of the bases absorbed by soil, we conclude, upon the evidence thus before us, that they are combined either with hydrated metallic oxides, with hydrated double silicates, or possibly with humus.

Our conclusions respecting the cause and manner of soil absorption may be summarised as follows:—

1. It appears that the hydrated ferric oxide and alumina of soil have a notable power of absorbing phosphoric acid from the solutions of its salts, and, to a much smaller extent, a capacity for taking up sulphuric, hydrochloric, and nitric acid (at least if these acids are presented in the form of ammonium salts) and that in all these cases the product of the absorption is a highly basic compound of the acid with the metallic oxide. It appears, further, that these metallic hydrates are also capable of absorbing bases, with which they either combine directly, or form highly basic double salts with acids either previously or at the same time absorbed. The hydrates are, however, incapable when alone of affecting any considerable absorption from a chloride or nitrate, although in the soil they probably absorb bases from these salts without difficulty, owing to the decomposing action of the lime of soils.

2. The hydrated double silicates contained in soil also exercise a very considerable absorptive power, which is confined to bases. The hydrated silicate of aluminium and calcium is capable of absorbing potash or ammonia from all the salts of these bases, and probably with nearly equal energy from each. The product in each case is a new hydrated double silicate, in which the calcium is more or less perfectly replaced by potassium or ammonium (the calcium thus displaced combining with the acid of the potassium or ammonium salt).

3. The humus contained in soil appears also to be capable of forming, to some extent, insoluble compounds with bases.

4. Some of the calcium salts contained in soil, probably the carbonate, the silicate, and compounds of lime with ferric oxide and alumina, assist in several ways the operation of soil-absorption. By combining with the acids of certain salts, as carbonates, sulphates, chlorides, nitrates, they allow the bases of these salts to unite with the hydrated metallic oxides. The carbonate of calcium also converts the soluble acid phosphates applied in manure into sparingly soluble calcic phosphates, which, as they gradually enter into solution, are converted into ferric and aluminic phosphates, as already described.

5. Lastly, besides these chemical actions of the ingredients of soil, several of the component parts of soil possess the power of attracting to their surface certain organic and sparingly soluble compounds, by virtue of simple physical adhesion. This power is apparently possessed by clay, by the hydrated metallic oxides, and possibly by humus. To the existence of this power the decolourising and clarifying properties of soil are due.

The absorptive power of soil does not therefore reside in a single ingredient, nor is it to be attributed to a single action. Soils of very various character and composition may equally enjoy this important property. With clay soils the silicates and alumina will chiefly sustain the action; with loams and sandy soils the ferric oxide will play an important part; with pasture soil the action of the humus rises in significance. It is not to be supposed, however, that absorption in all these cases amounts to the same thing. The compound of a base with a silicate, with a metallic hydrate, and with humus, must, in every

* We should expect from the results obtained when sulphate of ammonium was placed in contact with hydrated alumina and ferric oxide, that under some circumstances sulphuric acid would be retained in the soil to an appreciable extent. Curiously enough, this fact was noticed by Mr. H. S. Thomson in his original experiments of 1845. I have found no reference to it since. He observed that a solution of sulphate of ammonium became *alkaline* on being filtered through soil. The reaction would probably be observed in the case of soils rich in the hydrated oxides, but poor in lime.

† Eichhorn has examined the properties of chabazite, a native hydrated silicate of aluminium and calcium; he found that, placed in contact with a solution of chloride of ammonium, it absorbed a large quantity of ammonia and parted with lime, and in other respects comported itself like Way's artificially prepared silicate.

‡ *Jahresbericht der Agrikultur-Chemie*, 1859-60, p. 1.

case, possess distinct properties, will probably resist in a different degree the solvent action of water, and be variously affected by other chemical agents. The difference to the plant between these different compounds may, possibly, be considerable. The relation of both the quantity and kind of the absorptive power of a soil to its fertility, and the influence of cultivation upon both aspects of this property of soil, is, I believe, a subject yet untouched, and can, perhaps, hardly yet be attempted until more perfect investigations have been made upon the elementary parts of this great question. These, we need scarcely say, are greviously needed. When will the country that owes so much to agriculture, and depends so greatly upon its successful pursuit for prosperity, perceive the importance of directly furthering such objects? Germany has its forty-five experimental stations, supported by the respective Governments, these establishments being devoted to the scientific study of agricultural questions. England, to the honour of individual effort, possesses one station (that at Rothamsted) which all admire, but none have imitated. The labours of our voluntary workers have contributed many valuable miscellaneous researches. The agricultural societies of this country, and the college at Cirencester, have also done good work: but for the task before them these institutions are, both singly and collectively, inadequate. Until, in fact, the prosecution of agricultural science is acknowledged to be an object worthy of national exertion, the thorough investigations which the subject demands can hardly be expected.

DETERMINATION OF IRON WITH DICHLORIDE OF COPPER.

By Dr. WINKLER.

DURING the last few years, much labour has been spent in order to find a method of determining iron volumetrically, based on the conversion of sesquioxide to protoxide.

The reducing agents that have been in use up to this time are protochloride of tin and iodide of potassium; but the dichloride of copper is now found to be a much more powerful reducing agent for sesquioxide of iron, though analogous to protochloride of tin in its effects. While protochloride of tin causes but a partial reduction in a cold solution, dichloride of copper acts directly with theoretical accuracy at the lowest temperature, and in any dilution. It is, therefore, particularly adapted for the volumetric determination of iron.

The completion of the reduction may be ascertained with certainty by the addition of a few drops of sulphocyanide of potassium to the solution to be tested, when the well-known deep-red colour appears. When the dichloride solution is dropped into one of iron so coloured, the red colour becomes lighter and lighter, and finally disappears entirely. After the solution is bleached, the reduction of the iron is complete, and the next drop of copper solution causes a precipitate of the disulphocyanide of copper. This gives a double indicator of the end of the reduction, namely, the blacking of the red colour of the sulphocyanide of iron, and the cloudiness produced by the insoluble salt of copper.

The rapidity and simplicity of the process, as well as the few accessories required, recommend this method, especially to technical laboratories, where the want of a short and accurate process has ever been felt. For carrying out the above-mentioned determination, there is needed:—

1. *A solution of dichloride of copper.* This is made by dissolving sheet-copper in nitric acid; then evaporate, to drive off the excess of nitric acid; and the residue is taken up in water containing hydrochloric acid. This solution is put into a flask, and a quantity of common salt (NaCl) equal in weight to the residue of dry copper-salts is added, in order to prevent the separation of a precipitate of dichloride of copper during the subsequent reduction. Several pieces of sheet-copper are put in the flask, and it is then heated to boiling. This is continued until the solution is nearly colourless, and all the chloride of copper has been changed to dichloride. The flask is then corked, and allowed to cool; then the solution is diluted with water containing hydrochloric acid until 1 cubic centimetre corresponds to 6 milligrammes of iron. In order to keep this solution without change for further use, it should be poured into a bottle, to which is fitted an air-tight stopper, and a spiral of thick copper wire reaching from the bottom to nearly the neck. This completely protects the dichloride of copper from a higher oxidation, so that the strength of the solution remains nearly always the same. In all cases it is best and most accurate to determine the strength of the standard from time to time, since this requires but a few minutes; therefore, for this purpose, there is needed—

2. *A solution of sesquichloride of iron* of known strength. This may be made, according to Fresenius, by dissolving in hydrochloric acid and chlorate of potash 10·03 grms. of piano-wire, corresponding to 10·000 grms. of pure iron, and diluting to 1 litre. For each test of the standard, 10 c.c. of this solution is taken, which contains 100 milligrammes of iron.

In noting the end of the reduction, though it is not necessary that the solution of sulphocyanide of potassium should contain a known amount of this salt, yet it will be found better to use about the same strength at all times, since the presence of too much sulphocyanide makes the reaction less marked.

In performing this volumetric determination of iron, there are but few rules to be observed. It is advisable that the solution to be treated be quite acid and very dilute before it is brought under the burette. A solution that contains 100 to 200 milligrammes of iron should be diluted to 500 c.c. or more.

In adding the sulphocyanide, care must also be taken; for, if too much is added to the iron solution, although a deeper blood-red will be obtained, yet a difficultly-soluble sulphocyanide of copper may separate, clouding the solution and re-dissolving with trouble. Four or five drops of the above-mentioned solution are quite sufficient to be added. Then, by dropping in the copper solution, the bleaching takes place with extraordinary sharpness, and only when all the iron has become a protoxide does the next drop cause a permanent cloudiness.

The presence of coloured metallic compounds (as salts of cobalt, nickel, and copper) does not in the least hinder the recognition of the reactions, if the solution is properly dilute. Neither does the presence of arsenic acid affect the process, since this is not reduced by dichloride of copper. This process, therefore, is important to the metallurgist, who is often compelled to determine quickly and correctly the amount of iron contained in a matt, or speiss, or other product. By the above process, this is possible in an hour.—*Journ. für Prakt. Chem.*, vol. xcv., No. 15.

ON AMMONIA-CHROMIUM BASES.

CLEVE has communicated to the Royal Swedish Academy of Sciences a memoir on the ammonia-chromium bases. The author sets out with the chloride discovered by Fremy, and investigated to some extent by himself in a previous memoir. To this he gives the formula—

$$Cr2Cl_3,4NH_3,2HO,$$

and the name tetramin chrom-chloride. It will be sufficient for our purpose to give the formulæ of the various compounds, with a general account of their properties.

The formulæ of the salts described by Cléve belonging to the tetramin series are as follows:—

Chloride,	$Cr_2Cl_3,4NH_3,2HO$.
Chlorplatinate,	$Cr_2Cl_3,4NH_3,2HO+2PtCl_2$.
Chlorhydrargyrate,	$Cr_2Cl_3,4NH_3,2HO+6HgCl$.
Chlorobromide,	$Cr_2ClBr_2,4NH_3,2HO$.
Bromide,	$Cr_2Br_3,4NH_3,2HO$.
Bromochloride,	$Cr_2BrCl_2,4NH_3,2HO$.
Chloro-iodide,	$Cr_2ClI_2,4NH_3,2HO$.
Iodide,	$Cr_2I_3,4NH_3,2HO$.
Chlorosulphate,	$Cr_2ClO_2,4NH_32SO_3,2HO$.
Bromosulphate,	$Cr_2BrO_2,4NH_32SO_3,2HO$.
Chlorochromate,	$Cr_2ClO_2,4NH_32CrO_3,xHO$.
Chloronitrate,	$Cr_2ClO_2,4NH_3,2NO_5,2HO$.

All these salts are crystalline and easily soluble in water; they have a carmine-red or garnet-red colour, and their solutions are easily decomposed on heating, with separation of chromic oxide and evolution of ammonia. The author calls attention to the very noteworthy fact that they all contain 2 atoms of water (in the old notation).

The second series of compounds described are the salts of heptamin-dichromium.

The formulæ of the only observed members of this series are as follows:—

Double nitrate.

$$2(Cr_2O_3,3NO_5),7NH_3+NH_4O,NO_5+9HO.$$

Oxalo-nitrate.

$$2(Cr_2C_3,NO_5,(C_2O_3)_2),7NH_3+6HO.$$

The salts of the triamine series are as follows:—

Oxalate.

$$Cr_2O_3,3C_2O_3,3NH_3,3HO.$$

Double oxalate.

$$2(Cr_2O_3,3C_2O_3.3NH_3)+NH_4O,2C_2O_3,HO+3HO.$$

The salts of the heptamin and triamin series resemble those of the tetramin series so closely as not to require special description. The nitrate of the heptamin series is obtained by the action of nitrate of silver upon the chloride of tetramin-chromium. The oxalate of the triamin series is obtained by the action of oxalic acid upon the same chloride. Besides these three series, the author describes the following salts, which may obviously be regarded as members of other and analogous groups:—

$$Cr_2O_3,NO_5,2NH_3+3HO$$
$$Cr_2O_3,C_2O_3,NH_3+8HO$$
$$2(C_2O_3),SO_3,2NH_3+24HO$$

It is, however, very doubtful whether these three substances were obtained in a state of purity, as they were all amorphous, and could not be obtained crystallised.—*Kongliga Svenska Vetenskaps-Akademiens Handlingar, Ny Följd*, vol. vii., 2nd half.

[*Note, by* Dr. WOLCOTT GIBBS.—The compounds described by Cleve are of especial interest when considered from an atomistic point of view. The formulæ of the triamin and tetramin series are, of course, to be doubled; and we should then have, for the three chlorides, the empirical formulæ—

$6NH_3,Cr_2Cl_6$,	Hexamin-chromium chloride.
$7NH_3,Cr_2Cl_6$,	Heptamin-chromium chloride.
$8NH_3,Cr_2Cl_6$,	Octamin-chromium chloride.

Adopting Blomstrand's view of the constitution of the analogous platinum and cobalt compounds, these three bodies may be written as follows:—

$$Cr_2^{vi}\begin{cases}-NH_2-Cl\\-NH_2-Cl\\-NH_2-Cl\\-NH_2-Cl\\-NH_2-Cl\\-NH_2-Cl\end{cases} \quad Cr_2^{vi}\begin{cases}-NH_2-Cl\\-NH_2-Cl\\-NH_2-Cl\\-NH_2-NH_2-Cl,\\-NH_2-Cl\\-NH_2-Cl\end{cases} \quad Cr_2^{vi}\begin{cases}-NH_2-Cl\\-NH_2-Cl\\-NH_2-NH_2-Cl\\-NH_2-NH_2-Cl\\-NH_2-Cl\\-NH_2-Cl\end{cases}$$

Cleve suggests that the heptamin series may be only double salts of his tetramin and triamin compounds; and, in view of the unsymmetrical structure of the chloride, this seems at least probable. It is also to be borne in mind that the want of symmetry is only seen if we adopt Blomstrand's theoretical views, and does not appear when the ammonia bases are formulated according to the principles of variable atomicity supported by the writer.* The invariable occurrence of 2 atoms of water in all the octamin compounds is difficult to explain upon any theory. —*American Journal of Science*, vol. xlix., p. 251.

USE OF A BELL-JAR AND BEAKER WITH BUNSEN'S PUMP.

By ALBERT R. LEEDS.

THE following attachment to Bunsen's pump (see CHEMICAL NEWS, vol. xix., p. 161), which suggested itself some time ago has now been in use for several months, and its merits are such as to deserve more particularly the attention of chemists. Instead of the cumbrous bottle generally employed, the plate of an air-pump may be advantageously substituted, and a receiver, with an india-rubber cork, through which the neck of the funnel is passed, as represented in the drawing. In order to prevent loss by the bursting of bubbles of air at the end of the tube of the funnel, it is continued low down into the beaker by an india-rubber tube, A. The latter can easily be removed at the end of a filtration, and the drops of adhering liquid, washed with water from the spritz, into the filtrate. This simple arrangement obviates the necessity of a transfer from one vessel to another, and permits all the operations of an analysis to be carried on as usual, in beakers. Instead of an air-pump plate, a sheet of glass may be used, and the exhausting tube as well as the funnel in this case must be passed through the tubulure of the bell-jar. A similar arrangement is useful for the desiccation of bodies, either alone or with sulphuric acid. —*Journal of the Franklin Institute.*

IMPROVED FORM OF WASH-BOTTLE.

By ALBERT R. LEEDS.

THE accompanying drawing represents a wash-bottle which I have seen in use abroad, but which I have not seen in text-books or employed at home. The delivery tube, A, is bent sharply upon itself, and then cut off at a point not quite directly above where it makes the first bend. The jet is bent in the same manner but in a contrary direction, and the two parts are connected by an india-rubber tube. Over this is fitted a short piece of glass tube, of such a bore as to fit tightly, yet permit, at the same time, the jet to be pointed upward, downward, or in any direction. In transferring precipitates from one beaker to another, or in washing a precipitate back into a beaker, &c., such a form of wash-bottle is much more convenient than that in common use. B is the entrance tube; C, cork tied around the neck of the bottle; D D D, pieces of india-rubber tubing where the glass tubes, in order to give greater flexibility, are cut into parts. The delivery tube is bent at E so as to reach into that corner which is lowermost when the flask is inclined.—*Journal of the Franklin Institute.*

* *American Journal of Science*, vol. xlix., p. 108.

CORRESPONDENCE.

ESTIMATION OF CHLORINE IN NATURAL WATERS.

To the Editor of the Chemical News.

SIR,—Mr. Blunt has given, in the last number of the CHEMICAL NEWS, a method of determining chlorine volumetrically in natural waters. He seems to be unaware that this process has been published many years (see Fresenius's "Quantitative Analysis," p. 310, 4th. edit., 1865). The credit of first using potassic chromate as an indicator is due, I believe, to Mohr. To my personal knowledge it has been in use daily for the last three years at the Royal College of Chemistry, and where I do not think they would be satisfied with the results first cited, viz:—

Volumetrical estimation.	Gravimetrical estimation.
0·994	0·8904

or a difference of 0·1.—I am, &c.,

SCRUTATOR.

TETRABROMIDE OF CARBON.

To the Editor of the Chemical News.

SIR,—My attention having been called to a report of our paper on CBr_4 (carbon tetrabromide), in a recent number of the CHEMICAL NEWS, I must ask you to correct an error of some importance. So far from our proposing the action of *terbromide of antimony* on carbon disulphide as a means of preparing tetrabromide of carbon, I am not aware that these two substances have any action upon one another at the temperature specified (150° C.)—I am, &c.,

CHARLES EDWARD GROVES.

17, Rodney Street, Pentonville.

[Our report was official.—*Ed. C.N.*].

MISCELLANEOUS.

New Locality and Commercial Source of the Oxides of Nickel and Cobalt.—In a letter to the editor of the *Journal of the Franklin Institute*, Mr. C. P. Williams says that—"Of the auriferous deposits of Nueva Providencia, Venezeula, thus far opened and worked, the vein known as 'La Corina' has been most thoroughly exploited. Operations on it have extended already to the depth of upwards of 70 feet, and have developed a vein of about 4 feet average thickness, with a general N. E.—S. W. course, and standing at a high angle. The wall rocks are, even to this depth, completely decomposed and converted into clayey masses of various colours (locally used for pigments), but are separated from the compact hard white quartz of the vein by heavy and well-marked selvages or seams, of a soft black manganiferous substance, resembling, in appearance and physical properties, the variety of wad known as *asbolite*, but differing from that mineral in giving no reactions of water of combination (after being freed from its hygroscopic water by drying at 100° C.), and in showing a very considerable percentage of oxide of nickel. The substance forms, not only the selvages or flucans of the veins, but also the gossan, and fills the seams of the disturbed and shattered portions of the lode, appearing as a cementing material, as it were, of the fractured quartz, and giving to the vein a brecciated structure. Assay shows it to be quite rich in gold, containing the metal in workable amounts. With hydrochloric acid it is completely decomposed, liberating chlorine with the separation of gelatinous silica. The following is an analysis of the substance (dried at 100° C.) made by Mr. Roberts Le Boutillier, a pupil in my laboratory:—

	Per cent.
Protoxide of manganese	46·973
Oxygen, in combination with above	7·545
Sesquioxide of iron	4·073
Alumina	15·934
Oxide of copper	0·528
Oxide of cobalt	3·555
Oxide of nickel	10·385
Oxide of zinc	traces
Lime	1·605
Magnesia	1·653
Silicic acid	8·653
	100·264

The oxides of nickel and cobalt were separated by means of the nitrite of potassa method. The available oxygen was determined in the usual method for the valuation of manganese ores—that is, by means of its conversion into carbonic acid in the presence of oxalate of potassa and sulphuric acid. This mineral is not confined to La Corina, but is so abundantly distributed throughout the gold region of Venezuela, that it may ultimately become an important source of raw material for the preparation of nickel and oxide of cobalt; and with this in view, the writer makes the notice of its occurrence public. A. B. Garner, Esq., to whom I am indebted for the specimens for analysis, as well as for most of the facts with regard to the manner in which they occur, assures me the substance is the common accompaniment and gossan of other auriferous veins of the region."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, May 1870.

This number, an unusually small one, in consequence of the preoccupation of the French concerning the Plebiscite, contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Substances Isomeric with Cyanuric Ethers.—Dr. A. W. Hofmann and O. Olshausen.—This lengthy paper is substantially the same as that quoted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 6 (CHEMICAL NEWS, vol. xxi., p. 227).

Geological and Mineralogical Description of the Spanish Provinces of Murcia and Albacete.—F. de Botella.—The celebrated geologist, M. Elie de Beaumont, while presenting to the Academy the work of this author, published under the above-named title by order of the Spanish government, speaks in very highly eulogising terms on the great merits of this work, especially, also, for the great value of the work for the practical miner.

The Sun's Spots.—L. Sonrel.—The author presents to the meeting a series of photograms, taken daily since the 12th ult., representing accurately the changes the spots have undergone during the month.

Respighi's Theory of Scintillation.—H. Tarry.

Differences which the Value of one and the same Musical Interval Possesses, according to its being methodically heard—that is to say, with successive or Harmonious Sounds.—G. Guéroult.

Molecular Action Studied as being founded on the Theory of Capillary Action.—C. A. Valson.

On Sand and Blood Rains.—H. Tarry.—After referring to the erroneous and superstitious opinions held on this subject in former ages, the author explains, at length, his sound reasons for averring that, as far, at least, as the southern parts of Europe are concerned

these phenomena are due to dust and finely-divided sand carried over from Africa across the Mediterranean by cyclones, the course and origin of which is fully explained; but the author admits that the ashes and lapilli of volcanoes have often been carried through the atmosphere for enormously-great distances, and thus contributed to constitute what was termed rain of ash, or dust, or even blood, according to the colour of the materials, sometimes accompanied by real rain.

Method Employed by M. Jamin for the Determination of Specific Heat.—Dr. Pfaundler.—This paper is solely written with the view to prove and unequivocally establish the author's priority in reference to the use of the method alluded to.

Preparation of Bromide of Sodium on the Large Scale.—M. Castelhaz.—The author, a manufacturing chemist, states, in the first place, that, according to the communications received by him from several physicians who have applied bromide of sodium in their practice, instead of bromide of potassium, the efficacy of the former is far greater than that of the latter. As regards the preparation of this salt, the author says—The best plan is to prepare, first, bromide of ammonium, by causing bromine to fall drop by drop into dilute, but pure, liquid ammonia contained in a series of Wolff's bottles, in order thus to prevent the loss otherwise inevitably resulting from the volatilisation of the products formed by the great heat disengaged on the bromine and ammonia uniting. The liquids, after saturation, are evaporated in a cast-iron retort, to which an earthenware receiver is fastened, wherein are collected the vapours of water, any excess of ammonia, and some bromide of ammonium, which is accidentally carried over. The bromide of ammonium thus obtained is converted into bromide of sodium, by being mixed with pure carbonate of soda, and the application of sufficient heat to volatilise and sublime the carbonate of ammonia formed by the reaction. This mode of preparation yields, after re-solution of the bromide in water, and evaporation similar to that used for chloride of sodium, perfectly pure and anhydrous bromide of sodium.

Cosmos, May 7, 1870.

Utilisation of Sewage-Water for Irrigating Purposes.—M. Lecouteux.—The author gives an account of the experimental trials arranged at some short distance from Paris, where a daily quantity of no less than 6000 cubic metres (equal to rather more than 210,000 cubic feet, or 6000 tons' weight) of sewage-water is run over a surface of 6 hectares, of what used to be an unfertile soil, which, by this means, has been converted into productive market-garden ground. The author speaks highly of the success obtained in every respect, especially also as regards the very efficient retention by the soil of all suspended materials of the water.

New Arrangement for the Bichromate Battery.—Dr. Chuteaux.—In order to obviate the want of constancy and the strong polarisation of the bichromate battery, due to the deposition of chromium alum on the zinc, the author adds bisulphate of mercury, and, by a peculiar arrangement, causes the liquid to be renewed by circulation.

Ancient Glaciers of the Central Plateau of France.—E. Collomb.—A first instalment of a very interesting geological paper. By central plateau, is meant that portion of France which is the most elevated above the sea level. The size of this plateau is 300 kilometres from north to south, and about the same from east to west.

Preserved Meat.—Dr. Stein.—The author, while lecturing last Saturday week, at Dresden, on the preservation of food, produced a tin canister, of good size, containing butcher's meat preserved by Appert's method, and prepared by himself in 1851. On opening the canister, which was filled nineteen years previously, the meat was found to be as fresh and full of flavour as when it was first placed in the canister.

Zeitschrift für Chemie von Beilstein, No. 7, 1870.

This number opens with the programme for the prize essay of the Beneke Stiftung, at Göttingen. This document, leaving out of the question the rather lengthy introduction to the real subject proposed, is the following:—A new and very exact determination of the atomic weights of the earthy metals (Erdmetalle); also the precise determination of the limits of error of the experiments made; and, moreover, a critical review of the labours of various authors made in this direction. The proposers also require elucidation of the question, whether the hypotheses of Prout and Dumas are to be retained or rejected; and it is also desired that the author should investigate the point in how far the differences existing between these hypotheses may be explained on physical or chemical grounds. Answers may be sent, written in German, Latin, French, or English languages, on or before the 31st of August, 1872, to Dr. W. Müller, at Göttingen; and the distribution of the prizes (the first being of the value of £75, and the second of the value of £30) takes place at Göttingen, on the 11th of March, 1873. Each essay should bear a motto, and be accompanied by a sealed billet, bearing outside the same motto, and inside the author's name and address—the essays, &c., to be sent carriage or postage paid.

The number contains the following original papers:—

Electrolytic Experiments.—P. Burckhard.—After describing, at some length, the arrangements made for these experiments, the author states—Oxide of bismuth, Bi_2O_3, is not a conductor of electricity unless it be in state of fusion, but in that case one of the copper electrodes becomes coated with bismuth; while, if platinum electrodes are used, there is formed at one of the electrodes a very fusible alloy of the two metals. Fused borax is not a bad conductor, although the author confirmed the statement, made by Dr. Tichanowitsch, that pure boric acid does not conduct electricity at all. When borax in fused state is experimented with, a series of compounds are formed or volatilised; but the main result is its decomposition into soda, oxygen, and boron. Pyrophosphate of soda in fused state yields, among the products of electrolysis, phosphide of platinum, if a platinum electrode be applied; but the decomposition, which is chiefly the result of the electrolysis of this salt, is its splitting up into oxygen, phosphorus, and soda. Carbonate of soda in fused state is a good conductor of electricity; it is decomposed into carbonic acid and soda, but a small portion of carbon is also formed.

Moniteur Scientifique, No. 321, May 1, 1870.

This number contains the following original papers relating to chemistry or collateral sciences:—

Preparation of Liquid Iron Soap.—Dr. Hildwin.—Under this name there is used, as liniment against burns, a substance which the author states to be oleate of iron, prepared by heating, on a water-bath, oleic acid, and adding thereto, gradually, freshly-precipitated peroxide of iron, which, while the mixture is continually stirred, is readily dissolved. Oleates of other metallic oxides may be prepared in the same way.

First Importation of Cinchona Bark from Java.—It appears that, towards the end of last year, a quantity of some 930 lbs. of this bark has been exported from Java to the Netherlands. According to analysis made by Dr. B. Moens, in Java, this bark contains from 2·4 to 7·5 per cent of alkaloids, of which quantity 0·59 to 3·67 is quinine. The loss of weight occasioned by the drying of the bark has been found to amount to 66 per cent. There is every prospect that within some six or seven years hence Java will largely export this drug; and the cultivation of the cinchona trees is also to be extended to Sumatra, Celebes, and the Moluccas.

Annalen der Physik und Chemie, von Poggendorff, No. 3, 1870.

This number contains the following original memoirs and papers:—

Course of Electric Currents through Gases of Various Density (Sp. Gr.), and between Poles of Different Shapes.—E. Edlund.

Composition of Tourmalines. (Second paper.)—C. Rammelsberg.—This memoir is divided into the following sections:—Behaviour of tourmalines at red heat; the boron of tourmalines; quantity of fluorine contained in tourmalines; degree of oxidation of iron in tourmalines; description of various tourmalines—viz., brown tourmaline from New York, brown from Windischkappel, tourmaline from Eibenstock, black tourmalin from Zillerthal, tourmaline from Orford, black tourmaline from Texas (Lancaster Co., Penn.), and several more. This paper is to be continued.

Theory of Colours.—Dr. J. J. Müller.

Emission, Absorption, and Reflection of the Kinds of Heat Radiated at Low Temperatures.—Dr. G. Magnus.—This lengthy memoir is divided as follows:—Emission and absorption; description of the experiments; absorption of heat through diathermic bodies; theoretical considerations; radiation of rock-salt; on the heat passing through plates of clear rock-salt of a thickness of from 2·5 to 3 m.m. at 150°; thicker plates of rock-salt; radiation of sylvine; on the heat passing through clear plates of sylvine of from 2·5 to 3 m.m. thickness at 150°; radiation of fluor spar; on the heat which passes through perfectly transparent plates of fluor spar of about 3·8 m.m. thickness at 150°; radiation of chloride and bromide of silver; on transparency.

Width of the Spectral Lines.—F. Lippich.

Figures of Sound formed by Vibrations of Air.—F. Melde.

Observations made on the Gas-Flame issuing from an Argand Burner after Removal of the Glass Chimney.—E. Reusch.

Improved Electric Light Regulator.—G. Mos.—Illustrated by engravings.

Influence of Musical Vibrations on the Magnetism of Iron.—Dr. Warburg.

Absorption-Spectrum of Iodine Vapours.—R. Thalén.

Minimum Diversion of a Ray of Light with Symmetrically-Arranged Prisms.

Chemical Composition of an Ancient Bactrian Coin.—P. Dewilde.—This coin contains, in 100 parts—Copper, 77·585; nickel, 20·038; cobalt, 0·544; iron, 1·048; tin, 0·038; silver, a trace; sulphur, 0·090—total, 99·343. This composition, the author observes, is very nearly that of the present current coin (25 centimes pieces) of Belgium, which contain 74·4 per cent of copper and 25·55 of nickel.

Feeble Electric Sparks.—P. Riess.

Complicated Pendulum Motion.—Dr. Emsmann.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, 1870.

At the opening of the Meeting of the 11th of April last, the President of this Society, Dr. C. Rammelsberg, alluded, in a brief but expressive speech, to the loss suffered by the death of Dr. G. Magnus. This number contains, in addition to the papers and memoirs to be mentioned presently, biographies of the late Drs. Werther and Erdmann, which, however, are not suitable for further mention here.

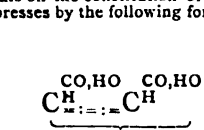
Formation of Chlormaleinic Acid from Benzol.—L. Carius.—Chlormaleinic acid, $C_4H_3ClO_4$, is a crystalline, white-coloured, solid substance; readily soluble in water, alcohol, and ether; fuses at about 171°; and, when heated to 180°, is converted into an anhydrous, oily fluid, which, in contact with water, yields again the solid hydrated acid; by the action of hydriodic acid at 120°, it is converted into ordinary succinic acid. Chlormaleinic acid is bibasic; its neutral alkaline salts are readily soluble in water. The acid potassa salt is a hard crystalline substance, $C_4H_2ClKO_4.OH_2$. The acid is formed when benzol is acted upon with the hydrate of chlorous acid.

Preparation of Dibromacetic Acid.—L. Carius.—The method alluded to is based upon the use of acetate of ethyl, instead of acetic acid; the action of the bromine upon the former is more regular, and the result is the formation of dibromacetic acid, bromethyl, and hydrobromic acid—

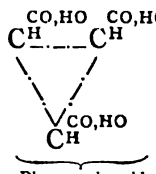
$$C_2H_3(C_2H_5)O_2 + Br_4 = C_4H_2Br_2O_2 + C_2H_5 + BrH.$$

In order to execute this process, acetate of ethyl and bromine are mixed in the proportion of $C_4H_8O_2 : Br_4$; and this mixture is heated to from 120° to 130° in sealed tubes. These, after the end of the operation, should be opened, being at the same time placed in ice-cold water, in order to prevent the too sudden evolution and escape of the hydrobromic acid.

Maleinic and Phenaconic Acids.—L. Carius.—This paper chiefly treats on the constitution of the acids alluded to, which the author expresses by the following formulæ;—



Maleinic acid.



Phenaconic acid.

Simple Mode of Formation of Acrylic Acid.—W. von Schneider and E. Erlenmeyer.—Owing to the very lengthy and complicated formulæ met with in this paper, it is not suited for abstraction.

Persulphocyanic Acid and Pseudo-Sulphocyanogen.—L. Glutz.—The author records his researches on the action of reducing agents upon persulphocyanic acid, $C_2S_3N_2H_2$, whereby he has obtained hydriodide of sulpho-urea, $CSH_2N_2I + CS_2$. When aniline acts upon persulsulphocyanic acid, there is formed a peculiar crystalline compound—

$$C_2S_3N_2H_2 + C_6H_7N = C_8S_2H_9N_3 + S.$$

Pseudo-sulphocyanogen has been considered to be free from oxygen. The author's researches, described at length, have led to the following formulæ, which prove that, when pseudo-sulphocyanogen is heated to about 140° in a sealed tube, it yields cyanuric acid, per-sulphide of hydrogen, sulphuretted hydrogen, and chloride of ammonium—

$$\underbrace{C_6S_3N_3H}_{\text{Pseudo-sulpho-cyanogen.}} + 3H_2O = \underbrace{C_3N_3H_3O_3}_{\text{Cyanuric acid.}} + H_2S + H_2S_2.$$

Researches on the Glycerine Compounds.—L. Henry.—This paper, a continuation of a former paper on this subject, is divided into the following sections:—On chloro- and bromo-nitro ether of glycerine; direct combination of the allyl compounds with chloride of iodine and hypochlorous acid; hypochlorous acid.

Transparency of Sulphuret of Lead (Galena) in Thin Plates.—L. Henry.—After referring to some well-known facts of transparency of metals in thin leaves, the author states that he accidentally discovered that galena in thin plates is transparent, transmitting light with a brownish yellow hue. The only heavy metallic sulphurets hitherto known as transparent are auripigmentum (sulphide of arsenic) and cinnabar (suulphide of mercury); galena, however, is distinguished from both these substances by possessing a metallic appearance.

Tin Compounds.—A. Ladenburg.

Manufacture of Artificial Alizarine.—H. Caro, C. Graebe, and H. Liebermann.—This is the German text of the English patents on this subject, dated June 25th, 1869.

On the Place to be Assigned to Thallium among the Elements.—C. Rammelsberg.—After referring to the difficulty of properly qualifying the place thallium should hold among the elements, the author describes the following salts of this element at length, viz.:—Thallium iodate, $TlIO_3$; dithallium iodate, $TlI_5O_{16} + 3aq$; thallium periodate; dithallium periodate, $Tl_2I_2O_{10} + 3Oaq$; potassium-dithallium chloride—

$$\left.\begin{matrix}6KCl\\TlCl_6\end{matrix}\right\} + 4aq;$$

ammonium-dithallium chloride—

$$\left.\begin{matrix}6AmCl\\TlCl_6\end{matrix}\right\} + 4aq;$$

potassium-dithallium bromide—

$$\left.\begin{matrix}3KBr_6\\TlBr_6\end{matrix}\right\} + 3aq;$$

potassium-dithallium iodide—

$$\left.\begin{matrix}3KI\\TlI_6\end{matrix}\right\} + 3aq.$$

Synthesis of Aromatic Acids.—V. Meyer.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg Vol. xiv., No. 5.

This number contains only one paper relating to physico-chemical sciences—

Influence of Heat upon the Elasticity of Caoutchouc.—J. Schmulewitsch.—The essay is, however, an algebraico-physical one, illustrated by diagrams.

Annales des Mines, No. 1, 1870.

This number contains, in addition to its officially-published reports and regulations, the following original memoirs, which are, however, too lengthy for anything more than a quotation of the titles:—

Record of Experiments on the Roasting of Silver Ores containing Sulphurets.—M. Simonnet.

Review of the Progress and Discoveries made in Geology during the last Two Years.—MM. Delesse and De Lapparent.—This comprehensive, but, of necessity, lengthy memoir, is an excellent compilation of everything done in Europe, as well as America and elsewhere, in this department of science.

Annales du Génie Civil, April, 1870.

Among a large number of papers on engineering contained in this number, we find the following:—

Method for Rendering Wood Difficultly Combustible, and for Preserving it when Underground.—Dr. Reinsch.—The wood, which must not be planed, is placed for twenty-four hours in a liquid composed of 1 part of concentrated silicate of potassa and 3 of pure water. After having been removed from this liquid, and dried for several days, the wood is again soaked in this liquid, and, after having been again dried, painted over with a mixture of 1 part of cement and 4 parts of the liquid above alluded to. After the first coat of this paint is dry, the painting is repeated twice. Of the paint-mixture alluded to, too large quantities should not be made up at once, because it rapidly becomes very dry and hard. Wood thus treated is rendered uninflammable, and does not decay underground.

Bayerisches Industrie und Gewerbe Blatt, March, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Some Considerations on the Selection and Use of Spectacles, especially in Reference to the Construction of the Human Eye.—Dr. Steinheil.—A lengthy paper, illustrated with cuts and diagrams.

Formation and Composition of Aniline Colours.—Dr. L. Janke,—A lecture on this subject, containing, in a moderately-lengthy paper, all that is essential on this subject, perfectly compiled. The paper is too lengthy for abstraction.

Water-Glass as a Solvent for Coralline.—C. Puscher.—The author dissolves coralline in a boiling mixture of one part of concentrated water-glass (silicate of soda or potassa of the consistency of a thick syrup) and 4 parts of water, and, after cooling, applies this solution as a paint for wood (white woods containing little or no tannic acid), by preference, paper, toys, artificial flower tissues, &c., to all of which materials this solution of coralline imparts a beautiful carmine-red tint.

The Journal of the Franklin Institute, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Beerising of Timber.—A. Ott.—A reply to Mr. Beer on some of the observations made by the author on his (Mr. Beer's) process of timber preservation. This paper contains some very sound observations on the causes of the decay of wood, and the uselessness of any simple coating to preserve that material.

New Chemical Nomenclature.—Dr. A. Ott.—Continuation of former papers on this subject. There is added to this paper, a table, embracing all the elementary bodies known with certainty, and their atomic numbers corresponding with the systems of Berzelius and Gerhardt, with new names added, and the names of lowest and highest oxide. As an instance, we only quote H—Name of one atom, "hydral"; name of a molecule (2 atoms), "hydrel"; name of lowest oxide, H_2O, "hydrelat"; name of highest oxide, H_2O_2, "hydrelt."

Eclipse Observations at Mattoon, Illinois, U.S.—Dr. G. W. Hough.

Electricity in Plants.—E. Smith.—A series of records of experiments on this subject taken, from the CHEMICAL NEWS.

February, 1870.

This number contains the following original items, papers, and memoirs:—

The Rider Vertical Engine and Valve.—Although not strictly a subject belonging to the matter generally treated by us, we call attention to this novelty, of American origin, illustrated by excellently executed woodcuts.

Use of Calcium Lights.—W. M. Roberts

Explosion of Fulminating Gold.—W. A. Street.

Nickel Linnæite.—A. R. Roessler.

The last three papers have already been communicated to our columns through the courtesy of Prof. Morton, the editor of the *Journal of the Franklin Institute.*

Electrical Measurements.—Dr. Gould.—This paper is the first instalment of an excellent abstract from a paper on this subject published originally in the "Smithsonian Contributions to Knowledge." The paper is too lengthy for useful abstraction, and illustrated with woodcuts. The experiments made relate to the Atlantic telegraph cables of 1865 and 1866.

Observations on the Planet Jupiter.—Dr. A. M. Mayer.—With a beautiful photo-lithographic coloured print of that planet, as seen on January 5 last, at Lehigh, Pennsylvania, U.S.

Revue Hebdomadaire de Chimie, April 28, 1870.

Melting and Sublimation Temperatures of some Poisonous Substances.—W. Guy.—We cannot reproduce all the figures here quoted, but the arrangement is excellent, and is as follows:—(1) Sublimates formed without any previous change of state of aggregation, and giving white vapours; under this head are brought bichloride of mercury, calomel, arsenious acid, and cantharidine. (2) Sublimates after previous fusion, and without leaving any residue—viz., oxalic acid. (3) Sublimate after previous fusion, leaving a carbonaceous residue—morphine and strychnine. (4) Fusion, change of colour, sublimation, deposition of carbonaceous residue, aconitine, atropine, delphine, veratrine, brucine, digitaline, picrotoxine, solanine. (5) Decrepitation; slow and partial sublimation; tartar emetic.

Elementary Organic Analysis of Wood to be used as Fire-Wood, after having been Exposed to Wind and Weather for more than a Year.—Ch. Mène.—The author records, in tabulated form, exhibiting in percentages the following particulars:—Water, carbon, hydrogen, oxygen, nitrogen, and ash for ten different kinds of woods.

Analysis of some Residues of the Operations of Malting and Brewing.—MM. Nivoit and Lefrange.—The authors exhibit, in tabulated form and in percentages, the analysis of the offal of malting—viz., the rootlets and plumules of the barley, the exhausted barley, dregs, after the infusion, and the exhausted hops—giving for each the full analysis of the ash therein contained, and making some useful suggestions as to the use which can be made of these materials.

Some Applications of Sympathetic Inks.—M. Mendis.

Bibliography.

This number ends with the review of "Eléments de Chimie Minérale ou Synthétique," par Dr. Sacc, at Neutchâtel. This book, published by Lacroix, at Paris, is very highly spoken of as a most excellent text-book for beginners. The work is especially recommended for medical and pharmaceutical students, engineers, and others, who, though not desirous of becoming professional chemists, want a certain amount of information therein.

Les Mondes, May 12, 1870.

Submarine Forest.—Dr. Quenault.—The author states that he has discovered, near Hauteville-sur-Mer, close to a rock (in the Atlantic Ocean, and near the French shore), known as *Le Manlieu*, a layer of peaty material, wherein are imbedded trunks of trees, yet held by their roots. Although at a depth of 12 metres under water, the oak is in perfect state of preservation, but all other kinds of wood have become soft and spongy. The author supposes that this forest was submerged in the 8th century.

Sugar Manufacturing Industry in France.—From a brief note on this subject, it appears that no less than eighty-nine new beet-root sugar works are in course of construction, while the acreage of land for the purpose of cultivating beet-root this season is larger than it has ever been.

Saccharate of Hydrocarbonate of Lime.—Dr. Felz.—This author states that, having thoroughly investigated this subject, he has found that there does really exist a peculiar compound of sugar and a specific hydrocarbonate of lime ($CaO,CO_2,5HO$), but that this compound is of a very ephemeral existence, since even a slight exposure to atmospheric air causes its decomposition, by the presence therein of carbonic acid. The utility of this compound in sugar refining is, however, very doubtful, since the author found that, unless very great care and skill are applied, large quantities of sugar may be lost.

Improved Holtz's Machine.—Rev. Father Secchi, S.J.—The eminent author states, in a letter addressed to the editor of *Les Mondes*, that Father Provenzali has greatly improved the instrument alluded to, and describes at some length, the effect of these alterations.

Steam-Engine for Domestic Use.—M. Fontaine.—The author describes at length, and illustrates with several woodcuts, this very useful contrivance. The makers are MM. Mignon and Rouart, Rue Oberkampf, 149 and 151, Paris. According to the description given, and the testimony of no less, already, than 100 owners of these engines, they are the most perfect hitherto brought out. It is stated, incidentally, that, with a consumption of 700 litres of coal-gas per hour, used as fuel (which is equal to 600 grms. of coal), 1-10th actual horse power is readily obtained. This result, the editor of the paper states, is very satisfactory indeed, considering the very small toy-like size of these engines.

NOTES AND QUERIES.

Indigo-Carmine.—Can any of your readers give me any information about the making of indigo-carmine?—J. D. S.

Lead Chromate.—Can any one assist me in the following difficulty:—I am desirous of preparing some lemon-coloured lead chromate—that is to say, the lead chromate as light in colour as possible. I have followed the directions given in books, by using dilute solutions of a neutral lead-salt and potassium chromate, taking care, also, to have the lead-salt slightly in excess. The precipitate falls of the desired colour on the first reaction; but, after washing by decantation for a few times, from day to day, it gradually becomes darker and darker in colour, until the orange chromate seems produced.—COLOURMAN.

Valuation of Gas Coal.—(Reply to "P. H.")—Take 100 grains of the coal, in small lumps, so that they may be readily introduced into a rather wide combustion-tube. This, at its open end, is (after the coal has been put in) drawn out, so as to form a narrow tube, which is to be bent at right angles; this narrower open end is to be placed in a wider glass tube, fitted tight into a cork fastened in the neck of a somewhat wide-mouthed bottle serving as tar vessel (hydraulic main of the gas-works). The cork alluded to is perforated with another opening, wherein is fixed a glass tube bent at right angles for conveying the gas, first through a chloride of calcium tube, next through a Liebig's potash-bulb, containing a solution of caustic potassa, wherein oxide of lead is dissolved. Next follows another tube, partly filled with dry caustic potassa, and partly with chloride of calcium; from this last tube, a gas delivery-tube leads to a graduated glass jar standing over a pneumatic trough, and acting as gas-holder. Before the ignition of the glass combustion-tube containing the coal is proceeded with, all the portions of the apparatus are carefully weighed, and next joined by means of india-rubber tubing. After the combustion is finished, which should be carefully conducted, so as to prevent the bursting, or blowing-out of the tube, the different pieces of the apparatus are disconnected and weighed again. You thus get the quantity of tar, ammoniacal water, carbonic acid, and sulphuretted hydrogen (as sulphide of lead); and you measure the gas by immersing the jar in water, causing it to be at the same level inside and out. Empty the Liebig's bulbs into a beaker-glass, and separate the sulphide of lead by filtration; wash carefully, and dry at 100° (of course you require for this either a previously dried and weighed filter or a counterpoise filter), from the sulphide of lead you calculate the sulphuretted hydrogen. This process, devised by the late Dr. T. Richardson, of Newcastle-on-Tyne, was found by him (by a lengthy and extensive practice) to yield very reliable results, so as to be suitable for stating what quantity of gas a ton of coal thus analysed would yield. The combustion-tube has to be weighed with the coal after it has been drawn out at its open end, and with the coke after the end of the combustion when it is again cold; and for that reason care is required in managing it.

MEETINGS FOR THE WEEK.

MONDAY, 23rd.—London Institution, 4.
—— Geographical, 8.30.
TUESDAY, 24th.—Institution of Civil Engineers, 8.
—— Ethnological, 4. Anniversary meeting.
—— Royal Institution, 3. Prof. Seeley, "On History."
WEDNESDAY, 25th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 26th.—Royal Institution, 3. Prof. Tyndall, "On Electricity."
—— Zoological, 8.30.
—— Philosophical Club, 6.
—— London Institution, 7.30.
FRIDAY, 27th.—Quekett Microscopical Club, 8.
—— Royal Institution, 8. Principal Dawson, "On Primitive Vegetation."
SATURDAY, 28th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."
—— Quekett Microscopical Club. Excursion to Chiselhurst. To Meet at Charing Cross Station, at 2 o'clock.

TO CORRESPONDENTS.

J. S. Norie, Sydney.—Received.

Thomas Rowan.—As a rule, we would prefer not to insert letters in these columns which refer to advertisements.

J. W. Slater.—M. Cocz's process for the preparation of extracts from dye-stuffs will be found in the *Bulletin de la Societe d'Encouragement pour l'Industrie Nationale* for 1867, 2e série, t. xv., p. 745.

John Hughes.—Consult either "The Nature and Properties of the Sugar-Cane, with Practical Directions for Cultivation and Manufacture of Products," published by Smith, Elder, and Co.; or, "The Sugar Planters' Manual," by Dr. Evans (2 vols.), published by Longmans.

BOOKS RECEIVED.

Science for the the People. By Thomas Twining, V.P.S.A. London: C. Goodman, 407, Strand.

Lecture Notes for Chemical Students. By Edward Frankland, F.R.S. Vol. 1. Inorganic Chemistry. (Second edition.) London: John Van Voorst, Paternoster Row.

THE CHEMICAL NEWS.

Vol. XXI. No. 548.

GOLD REFINING BY CHLORINE GAS.*

By F. B. MILLER, F.C.S.,
Assayer in the Sydney Branch of the Royal Mint.

(Concluded from p. 223.)

Very many thousand ounces (upwards of 200,000 ounces) have now been refined by this process; and the mode of operation which has, in practice, been found the most advantageous has been as follows:—

The French crucibles (say, size 17 or 18), duly prepared with borax, having been placed in the cold furnace, and slowly and carefully heated to dull redness, the gold (from 600 to 700 ounces to each crucible) is introduced, and the fire urged until the metal is melted, the necessary generation of chlorine having meantime been commenced by the introduction of a little hydrochloric acid, poured down the safety-tube, into the generators.

In order to fit the pots, and avoid the risk of splitting them by the wedging of the ingots at their contracted bottom, the gold for refining is cast in moulds of a peculiar form. Two inches from one end, the sides and bottom of the iron ingot-moulds converge so as to produce a slipper-shaped ingot, two of which, placed face to face, fit conveniently into the pot.

As soon as the gold is melted, from 2 to 3 ounces of borax in a state of fusion are poured upon its surface. If the borax is added sooner, it acts too much on the lower part of the pot; and, if thrown in cold, is apt to chill the gold. The clay pipe which is to convey the chlorine to the bottom of the melted gold is now introduced. (It is necessary to carefully heat the lower portion of this pipe for some ten minutes before introducing it into the molten gold, or it is apt to split). At the moment of its entering the melted gold, the screw compression-clamp is slightly loosened, so as to allow a small quantity of gas to pass through it, and thus prevent any metal rising and setting in the pipe, which is then gradually lowered to the bottom of the molten gold, where it is kept by means of a few small weights attached to the top. The compression-tap is now quite relaxed, and the gas is heard bubbling up through the melted metal, which it does quietly and without projection of globules from the pot.

Sufficient hydrochloric acid must be added to the generators, from time to time, to keep up a rapid evolution of chlorine. A rough general rule is to allow 1 imperial quart of acid of 1·15 sp. gr. to every 10 ozs. of silver in the alloy operated on.

The column of liquid in the safety-tube, acting, as it does, like a barometer, affords a ready means of knowing the pressure in the generator, and of judging of the rate of production of the gas, as well as at once showing, by its fall, if anything irregular has occurred—such as a leak or a crack of the chlorine pipe or pot. From 16 to 18 inches in the safety-tube correspond to and balance 1 inch of gold in the refining-crucible. When the chlorine is first introduced into the melted gold, a quantity of fumes are seen to pass up from the holes in the crucible-lid: these are not chloride of silver, but the volatile chlorides of some of the baser metals, and they are especially dense when much lead is present in the alloy under treatment, forming a white deposit on any cold substance presented to them. After a time, longer or shorter, according to the impurities in the gold, these fumes cease. So long as any decided quantity of silver is present in the molten gold, the whole, or nearly the whole, of the chlorine is absorbed, little, if any, appearing to escape, and to be thus wasted; and it is found that the better the supply of chlorine the quicker is the operation.

It is a curious circumstance that, though, in toughening with corrosive sublimate, this substance is only thrown on the surface of the melted gold, yet the whole mass is toughened by its action. It seems essential, in using chlorine, that the gas should pass to the very bottom to effect a complete refinage.

As soon as the operation is nearly over, fumes of a darker colour than those observed at the commencement make their appearance; and the end of the refinage is indicated by a peculiar flame or luminous vapour of a brownish yellow colour (occasioned by the free and now waste chlorine escaping), which can be seen on removing a small plug which fits into a hole in the lid of the pot. This, however, of itself, is not a sufficient indication: the process is not complete until this flame imparts to a piece of white tobacco-pipe, or similar substance, when held in it for a moment, a peculiar reddish or browish yellow stain; so long as it gives any other colour, the refinage is unfinished.

When these appearances are observed (usually for gold containing about 10 per cent of silver in about an hour and a half from the introduction of the chlorine), the gas is shut off, and the pots removed from the fire, the white crucible lifted out of the black one, and, together with its contents, allowed to stand seven minutes, until the gold becomes cool enough to set or solidify. The chloride of silver, which remains liquid much longer, is then poured off into iron moulds. The crucible is then inverted on an iron table, when the still red-hot gold falls out in the shape of a cone; this is slightly scraped, and then thrown, hissing, into a concentrated solution of common salt, to free it from any adherent chloride of silver.

An alloy containing originally 89 per cent of gold, 10 per cent of silver, and 1 per cent of base metals, will yield, on an average, a cake of chloride weighing, with a little adherent borax, 16 ozs. for every 100 ozs. operated on.

It is necessary very carefully to dry and heat the moulds into which the chloride of silver is poured, as the slightest moisture causes the latter to be violently dispersed while red hot, to the great risk of the bystanders. With ordinary care, this will never happen; but attention is called to the point, as a very deliquescent chloride of iron is apt to form on the moulds.

The gold is now fine, and simply requires re-melting into ingots.

As before stated, it is found that all these operations can readily be performed, and about 2000 ozs. refined per day in three common melting-furnaces, between 9 a.m. and 2 p.m. 98 per cent of the gold originally contained in the alloy operated on is then ready for delivery.

The other 2 per cent remains with the chloride of silver, partially in the metallic state, and partly in a state of combination with chlorine, and probably silver.

To free the chloride of silver from this combined gold (that mechanically mixed being eliminated at the same time), it is melted in a boraxed white pot, with the addition of from 8 to 10 per cent of metallic silver, rolled to about ¼ inch thickness. The chloride of gold is, by this means, reduced at the expense of the metallic silver, chloride of silver being formed; while the liberated gold sinks, and melts into a button at the bottom of the pot. As soon as the whole is thoroughly melted, the pot is removed from the furnace, and allowed to stand about ten minutes; and the still liquid chloride of silver is then poured into large iron moulds, so as to form slabs of a convenient thickness for the next operation, that is, its reduction to the metallic state.

After the fusion of the chlorides, a small quantity of a curious spongiform substance adheres to the sides of the crucible used, probably consisting of subchloride of silver; but, since it always contains a little gold, care has to be

* Read before the Royal Society of Victoria.

taken in pouring off the fluid chlorides, to prevent this auriferous sponge from falling out and mixing with them.

The fusion of the chlorides with metallic silver does not remove every trace of gold; but, with proper care, the amount remaining in the silver produced need not exceed 3 parts in 10,000, or about 2 grains of gold in every pound (troy) of silver—a quantity too small to pay for further extraction in this colony.

The slabs of chloride of silver are reduced, without difficulty, by plates of wrought-iron or zinc, in the usual way; but my friend and colleague, Dr. Leibius, has contrived a very excellent apparatus for this purpose.

The Manager of the Bank of New South Wales has kindly allowed me the use of 500 ozs. of Queensland gold to illustrate this paper. This quantity was divided into two nearly-equal parts: one portion, weighing 248 ozs., was left in its original unrefined condition, as seen in the ingot on the table; the other portion, weighing 252 ozs., was refined in the manner described above, and the resulting bar of fine gold, assaying 995, is placed by the unrefined ingot for comparison, and the silver extracted, weighing 38·8 ozs. and assaying 991·1, lies beside it.

Besides the separation and recovery of the silver as above described, another useful end is gained by this process.

A very large proportion of the gold of Australia (more especially that obtained by amalgamation from our quartz-veins) is more or less brittle—an effect generally due to the presence of small quantities of lead or antimony, rendering the bullion quite unfit for coinage or manufacture until it has undergone some process to render it tough.

The methods usually employed for this purpose are either fusion with nitre and borax, melting with oxide of copper, or the addition of corrosive sublimate (bichloride of mercury) to the melted gold. The two former of these plans are troublesome, from the corrosive action they exert on the crucibles; and the last (namely, the employment of corrosive sublimate, which is that usually adopted) is most objectionable, from the dense and highly injurious fumes evolved.

In Victoria, this is regarded as so serious a matter, in a public and sanitary point of view, as to have induced the Municipal Council of Melbourne to institute an action at law against the Union Bank, to compel them to abate the nuisance thus created by their gold-melting establishment. The passage of chlorine-gas through the melted gold is found to effect the complete toughening of the metal by the elimination, as volatile chlorides, of the materials which render it brittle, while the evolution of the deleterious mercurial fumes is avoided.

In the metallurgic treatment of the precious metals, some loss is always sustained; but that incurred in the process here described is not found to be excessive.

The average loss of gold in operating hitherto has been found to amount to 19 parts in every 100,000 of alloy treated, which is considerably less than would be met with in toughening an equal amount of gold with corrosive sublimate in the ordinary manner.

The loss of silver has amounted to 240 parts in every 100,000 of alloy operated on (containing, originally, say 10 per cent of silver).

There is no doubt that a considerable portion of both these losses would be recovered on further treating the pots and ashes remaining after the operation; and it is found that, as manipulatory skill is acquired, the proportional loss of silver appears to be decreasing.

In refining, on the large scale, gold containing 10 per cent of silver, the cost of the operation in Sydney, including labour and the above losses of gold and silver, but exclusive of rent of premises and superintendence, is about five farthings per ounce, but varying with the quantity of silver present in the alloy operated on.

In England, where hydrochloric acid is a waste product of the alkali-works, and all apparatus is cheaper, the cost of refining by this method would be proportionally less.

The fineness of the gold produced by this process varies from 991 to 997 in 1000 parts, the average, as found on a refinage of many thousand ounces, being 993·5, or 23 carats, 3½ grains. The remaining 6½ thousandths are silver; and this compares favourably with any of the previously known practical processes, none of which leave less silver than this in the resulting fine gold.

If the refined gold be subjected to a *re*-refinage by chlorine, the amount of silver left in it can be reduced to 0·2 per cent, just as in the refinage by the ordinary sulphuric acid process the same result can be obtained by subjecting the refined gold to a further refinage with bisulphate of potash. For practical working, however, this would probably never be attempted.

The silver resulting from this method of refining is tough, but its quality varies somewhat according to the gold originally operated on: if the alloy treated contains much copper, the greater part of this remains with the resulting silver, but the other metals are nearly all eliminated.

The fineness of the silver hitherto obtained has varied from 918·2 to 992·0 in 1000 parts, the average being 965·6.

Analysis of the silver resulting from the refinage of gold known originally to have contained, amongst the base metals in the alloy, copper, lead, antimony, arsenic, and iron, gave the following results:—

Silver	972·3
Copper	25·0
Gold	2·7
Zinc and iron	traces
	1000·0

A very extended series of experiments have been made at the Sydney Branch of the Royal Mint to test the value of this process; and the result has been (as mentioned by the Hon. the Colonial Treasurer, in his speech on the Budget, Oct. 14th, 1869) that "active steps are now being taken to bring the system into operation" in that establishment.

I have already, in the paper read before the Chemical Society, acknowledged the obligation I feel under to my brother officers, Mr. Robert Hunt and Dr. Leibius, for their kind help and encouragement in perfecting this process of refining; but my especial thanks are also due to Professor Smith, of the Sydney University, who, in the kindest manner, placed his laboratory at my disposal, to assist me in this matter, and also to Dr. Thomson and Mr. Edward Hill, for their valuable and friendly help.

ON THE SULPHO-ACIDS OF BENZOL.

By A. ROSS GARRICK,
Balyett, Stranraer, Scotland.

BENZOL furnishes a large number of substitution products, some of which have already been subjected to exact investigation, whereas still many remain comparatively unstudied, or, at most, but superficially; of these latter, the sulpho-acids form one series. A few members have been prepared and partially examined, but their connection with each other, and with corresponding derivatives of benzol, is as yet entirely uninvestigated.

Standing first in order of this series is sulphobenzolic acid, $C_6H_5SO_3H$, first prepared by Mitscherlich, in 1834 (*Pogg. Ann.*, vol. xxxi., pp. 283 and 634). It is most readily prepared by bringing together benzol with sulphuric acid, accelerating the action by gentle warming on the water-bath. The crude acid is then neutralised with lead carbonate, and by decomposing the lead-salt with hydrosulphuric acid, and evaporating, the free acid is obtained. It is crystalline, and forms small white four-sided plates, very deliquescent and readily soluble in water and alcohol. The crystallised acid has, according to Otto and Ostrop,

the formula $C_6H_5SO_3H+1\frac{1}{2}H_2O$. It is very stable, and can be boiled with water, with the alkalies, and with most acids, without decomposing. It is monobasic, and forms a series of neutral salts which are mostly well crystalline, all soluble in water, and most of them in alcohol.

In the year 1857, Hofmann and Buckton (*Ann. Chem. Pharm.*, vol. c., pp. 157—161) prepared disulphobenzolic acid from the above acid, by the simple assimilation of the elements of sulphuric acid. They first prepared sulphobenzolic acid, by treating benzol with sulphuric acid, and afterwards decomposing the lead or copper salt with hydrosulphuric acid. They then evaporated the sulphobenzolic acid so prepared on the sand-bath, until the evolution of white fumes proved that the greater part of the water had been volatilised. It was found by them advisable to heat the solution until a slight brown colouration appeared. The acid was then introduced into a dry retort, together with an equal volume of strong Nordhausen sulphuric acid, and the whole maintained at the boiling-point for two hours. The liquid was then reduced, by evaporation, nearly to the original bulk of the sulphobenzolic acid employed. The new acid is described by them as being, at this stage, of a dark brown colour, which cannot be removed by boiling with charcoal. Treatment, however, with an excess of oxide of lead, and decomposition of the filtrate by hydrosulphuric acid, furnished them with a liquid which was perfectly colourless.

The acid was characterised by them merely by the preparation and analysis of the barium-salt.

The foregoing research of Hofmann and Buckton proves the existence of a bibasic acid, containing two atoms of sulphur, and which, irrespective of any special view regarding its molecular arrangement, may be regarded as formed by the association of a hydrocarbon (corresponding to marsh gas), with two molecules of anhydrous sulphuric acid.

$$C_6H_62SO_3=C_6H_4\begin{cases}SO_3H\\SO_3H\end{cases}$$

Hofmann and Buckton conclude, as the general result of their investigation of the sulpho-acids, that all organic molecules, particularly in the nascent state, appear to be capable of assimilating the elements of one or two molecules of sulphuric anhydride.

The formation of the two groups of acids which are thus produced presents a great analogy with the production of the nitro-substitutes generated under the influence of nitric acid. All these compounds are generated with the elimination of water. In the action of nitric acid and sulphuric acid upon benzol, for instance, we have—

$$C_6H_6+HNO_3=\underbrace{C_6H_4NO_2}+H_2O.$$
Nitrobenzol.

$$C_6H_6+2HNO_3=\underbrace{C_6H_4N_2O_4}+2H_2O.$$
Dinitrobenzol.

$$C_6H_6+H_2SO_4=\underbrace{C_6H_5SO_3H}+H_2O.$$
Sulphobenzolic acid.

$$C_6H_6+2H_2SO_4=\underbrace{C_6H_5S_2O_6H_2}+2H_2O.$$
Disulphobenzolic acid.

The action of nitric acid upon organic bodies is by no means limited to the production of the nitro-compounds corresponding to nitrobenzol and dinitrobenzol; frequently additional substitutes are formed with elimination of various molecules of water. Hitherto, however, no substances have been observed in which the assimilation of sulphuric acid has gone farther than in the disulphoacids.

In 1857, Couper succeeded in preparing sulphobrombenzolic acid (*Ann. Chem. Pharm.*, cvi., 226). He first prepared brom-benzol; and, by bringing it together with sulphuric acid, and allowing the mixture to stand, he obtained crystals of sulphobrom-benzolic acid. The acid he describes as being very deliquescent. By the addition of ammonia to a solution of the acid, he prepared an ammonium-salt of difficult solubility.

These three are the principal sulpho-acids of benzol known at present. Of each of the two latter, according to the theory of Kekulé, three isomeric varieties can exist in which the substituting radicals would have the positions corresponding to the methyl molecules in the three known varieties of xylol or dimethyl-benzol.

With the disulphobenzolic acid, no attempt was made to prepare an isomeric variety. With the sulphobrombenzolic acid, the experiment was tried, which proved successful—an acid of the same composition being produced, which differs from the sulphobrom-benzolic acid of Couper very markedly in a number of characteristics.

With the study of these acids, I have connected the farther object of determining which of the varieties of the diatomic phenols (hydroquinone, pyrocatechin, resorcin) result from these acids by applying the method of Kekulé, Würtz, and Dusart for the preparation of the phenols from the sulpho-acids.

Disulphobenzolic acid, $C_6H_4\begin{cases}SO_3H\\SO_3H\end{cases}$

Disulphobenzolic acid is readily prepared by the method of Hofmann and Buckton (*Ann. Chem. Pharm.*, vol. c., pp. 157, 161). For this purpose, sulphobenzolic acid is first prepared by bringing together sulphuric acid and benzol in equal volumes, accelerating the action by gently warming. The lead-salt is then prepared by neutralising a solution of the acid with lead carbonate, evaporating, and crystallising. The salt is then decomposed with hydrosulphuric acid, and, on evaporating the solution, the free acid is obtained. The acid, after being freed from water by allowing it to stand for some time over sulphuric acid, is then introduced into a flask with an equal volume of Nordhausen sulphuric acid, and the whole maintained at the boiling-point for two hours. The liquid, which was very dark in colour, was then dissolved in water, neutralised with lead carbonate, and evaporated. The solution was then decomposed with hydrosulphuric acid, and the lead sulphide filtered off. At this stage, the solution had a reddish colour, which I found was entirely removed on preparing from this solution a lead-salt, and decomposing it with hydrosulphuric acid. The acid so prepared is very deliquescent; it is dibasic, and forms a series of salts which mostly crystallise well and are all soluble in water.

Salts of Disulphobenzolic Acid.

Disulphobenzolate of Lead, $C_6H_4(SO_3)_2Pb+2H_2O$.

The lead-salt obtained by neutralising a solution of the acid with lead carbonate forms small corny crystals moderately soluble in water.

Water estimation—0·6315 grm. of the salt dried in the air lost, at 110°, 0·0432 grm. = 7·34 per cent H_2O.

Lead estimation—0·5893 grm. of the dry salt gave 0·4050 grm. lead sulphate = 46·93 per cent Pb.

	Calculated.		Found.
$C_6H_4(SO_3)_2Pb$ ..	443	92·49	—
$2H_2O$	36	7·51	7·34
	479	100·00	

	Calculated.		Found.
$C_6H_4(SO_3)_2$	236	53·28	—
Pb	207	46·72	46·93
	443	100·00	

Disulphobenzolate of Copper, $C_6H_4(SO_3)_2Cu+4H_2O$.

The copper-salt forms small blue crystals, closely grouped together, easily soluble in water. At 110°, the crystals give off only a small portion of their water, and the remainder at 140°.

The salt is easily prepared from a solution of the lead-salt by precipitating the lead exactly with a solution of copper sulphate.

Water estimation—0·3515 grm. of the salt dried in the air lost, at 110°, 0·0672 grm. = 19·11 per cent H_2O.

Copper estimation—0·2843 grm. of the dry salt gave, on ignition, 0·0754 grm. of cupric oxide = 21·16 per cent Cu.

	Calculated.		Found.
$C_6H_4(SO_3)_2Cu$ ..	299·4	80·62	—
$4H_2O$	72·0	19·38	19·11
	371·4	100·00	
$C_6H_4(SO_3)_2$ ..	236·0	78·83	—
Cu	63·4	21·17	21·16
	299·4	100·00	

Disulphobenzolate of Zinc, $C_6H_4(SO_3)_2Zn+4H_2O$.

The zinc-salt crystallises in indistinct needles densely grouped together. It is readily soluble in water. To prepare it, the lead-salt is decomposed with that quantity of a solution of zinc sulphate necessary to precipitate the lead.

Water estimation—0·0927 grm. of the salt dried in the air lost, at 110°, 0·0177 grm. = 19·09 per cent H_2O.

Zinc estimation—0·1393 grm. of the dry salt gave 0·0371 grm. zinc oxide = 21·35 per cent Zn.

	Calculated.		Found.
$C_6H_4(SO_3)_2Zn$ ..	301	80·70	—
$4H_2O$	72	19·30	19·09
	373	100·00	
$C_6H_4(SO_3)_2$	236	78·41	—
Zn	65	21·59	21·35
	301	100·00	

Disulphobenzolate of Barium, $C_6H_4(SO_3)_2Ba+1\frac{1}{2}H_2O$.

This salt forms an apparently amorphous mass moderately soluble in water.

It corresponds to the barium-salt prepared by Hofmann and Buckton (*Ann. Chem. Pharm.*, vol. c., pp. 157—161), and described by them as forming an apparently amorphous mass, which, however, they found under the microscope to be distinctly crystalline, showing minute shuttle-shaped forms generally densely grouped together. When strongly heated on platinum foil, it burned with evolution of sulphurous oxide.

Water estimation—0·1515 grm. of the salt dried in the air lost, at 110°, 0·0100 grm. = 6·60 per cent H_2O.

Barium estimation—0·2335 grm. of the dry salt gave, on ignition, 0·1432 grm. barium sulphate = 36·53 per cent Ba.

	Calculated.		Found.
$C_6H_4(SO_3)_2Ba$ ..	373	93·25	—
$1\frac{1}{2}H_2O$	27	6·75	6·60
	400	100·00	
$C_6H_2(SO_3)_2$	236	63·28	—
Ba	137	36·72	36·53
	373	100·00	

Disulphobenzolate of Calcium, $C_6H_4(SO_3)_2Ca+1H_2O$.

The calcium-salt is readily soluble in water. It forms an apparently amorphous mass, which, however, on close examination, shows indistinct crystal forms. By neutralising the free acid with calcium carbonate, this salt is prepared.

Water estimation—0·2778 grm. of the salt dried in the air lost, at 110°, 0·0165 grm. = 5·93 per cent H_2O.

Calcium estimation—0·2613 grm. of the dry salt gave 0·1267 grm. calcium sulphate = 14·24 per cent Ca.

	Calculated.		Found.
$C_6H_4(SO_3)_2Ca$ ..	276	93·88	—
H_2O	18	6·12	5·93
	294	100·00	
$C_6H_4(SO_3)_2$	236	85·51	—
Ca	40	14·49	14·24
	276	100·00	

Disulphobenzolate of Potassium, $C_6H_4(SO_2KO)_2+\frac{1}{2}H_2O$.

The potassium-salt crystallises in small colourless distinct crystals. It is easily soluble in water, and is readily prepared from the barium-salt by decomposing it with a solution of potassium sulphate exactly necessary to precipitate the barium.

Water estimation—(1) 0·3648 grm. of the salt dried in the air lost, at 110°, 0·0103 grm. = 2·82 per cent H_2O. (2) 0·5390 grm. of the salt dried in the air lost, at 110°, 0·0177 grm. = 3·17 per cent H_2O.

Potassium estimation—0·4432 grm. of the dry salt gave 0·2448 grm. of potassium sulphate = 24·75 per cent K.

	Calculated.		Found.	
			I.	II.
$C_6H_4(SO_2KO)_2$.. ..	314·2	97·22	—	—
$\frac{1}{2}H_2O$	9·0	2·78	2·83	3·17
	323·2	100·00		
$C_6H_4(SO_3)_2$	236·0	75·12	—	
K_2	78·2	24·88	24·75	
	314·12	100·00		

Sulphobrom-benzolic Acid, $C_6H_4BrSO_3H$.

For the preparation of this acid, the method given by Couper (*Ann. Chem. Pharm.*, vol. cvi., p. 226) was adopted.

Monobrom-benzol was first prepared, and afterwards brought together with an equal volume of Nordhausen sulphuric acid, the action being accelerated by heating on the water-bath. The mixture was then dissolved in water, neutralised with lead carbonate, evaporated, and the lead-salt crystallised. This salt purified by re-crystallisation was then decomposed with hydrosulphuric acid, the lead sulphide filtered off, the solution exaporated and allowed to stand over sulphuric acid. Well-formed radiate crystals were obtained, very deliquescent, which melted at 88°. This acid is monobasic, and furnishes a series of well crystallised salts.

Salts of Sulphobrom-Benzolic Acid.

Sulphobrom-benzolate of Lead, $(C_6H_4BrSO_3)_2Pb$.

The lead-salt is readily prepared by neutralising a solution of the acid with lead carbonate, evaporating the solution, and allowing the salt to crystallise.

It forms large warty crystals pretty difficultly soluble in water.

Lead estimation—(1) 0·2565 grm. of the salt (110°) gave 0·1143 grm. lead sulphate dried at 100° until constant weight found = 30·44 Pb. (2) 0·6258 grm. of the salt gave, on ignition, 0·2745 grm. lead sulphate = 29·95 per cent Pb.

	Calculated.		Found.	
			I.	II.
$(C_6H_4BrSO_3)_2$	472	69·52	—	—
Pb	207	30·48	30·44	29·95
	679	100·00		

Sulphobrom-benzolate of Copper—

$(C_6H_4BrSO_3)_2Cu+6H_2O$.

The copper-salt forms large thin beautiful monoclinic plates of a blue colour, easily soluble in water. It is pre-

pared from a solution of the lead-salt by precipitating the lead exactly with a solution of copper sulphate.

Water estimation—1·1312 grms. of the salt dried in the air lost, at 110°, 0·1917 grm. = 16·94 per cent H_2O.

Bromine estimation—0·3410 grm. of the dry salt gave 0·1765 grm. silver bromide = 29·88 per cent Br.

Copper estimation—0·3303 grm. of the dry salt gave, on ignition, 0·0488 grm. cupric oxide = 11·79 per cent Cu.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2Cu$ ..	535·4	83·22	—
$6H_2O$	108·0	16·78	16·94
	643·4	100·00	
$(C_6H_4SO_3)_2$	312·0	58·43	—
Br_2	160·0	29·73	29·88
Cu	63·4	11·84	11·79
	535·4	100·00	

Sulphobrom-benzolate of Zinc, $(C_6H_4BrSO_3)_2Zn+6H_2O$.

The zinc-salt forms splendid colourless triclinic crystals moderately soluble in water. This salt is readily prepared from a solution of the lead-salt, by precipitating the lead exactly with a solution of zinc sulphate.

Water estimation—0·5688 grm. of the salt dried in the air lost, at 110°, 0·0976 grm. = 17·15 per cent H_2O.

Zinc estimation—0·4703 grm. of the dry salt gave 0·0691 grm. zinc oxide = 11·80 per cent Zn.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2Zn$ ..	537·2	83·27	—
$6H_2O$	108·0	16·73	17·15
	645·2	100·00	
$(C_6H_4BrSO_3)_2$	472·0	87·89	—
Zn	65·2	12·11	11·80
	537·2	100·00	

Sulphobrom-benzolate of Barium, $(C_6H_4BrSO_3)_2Ba$.

The barium-salt crystallises in splendid leaflets of a silver glance, easily soluble in water. By neutralising a solution of the acid with barium carbonate, and evaporating, this salt is readily prepared.

Barium estimation—0·3832 grm. (at 110°) gave, on ignition, 0·1451 grm. barium sulphate = 22·33 per cent Ba.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2$ ..	472	77·51	—
Ba	137	22·49	22·33
	609	100·00	

Sulphobrom-benzolate of Calcium—
$(C_6H_4BrSO_3)_2Ca+2H_2O$.

The calcium-salt prepared by neutralising a solution of the acid with calcium carbonate forms large colourless monoclinic crystals with the following forms—

$$\infty P \infty \breve{P} \infty \frac{P}{2}$$

which effloresce on being exposed to the air.

Water estimation—0·3979 grm. of the salt dried in the air lost, at 110°, 0·0274 grm. = 6·81 per cent H_2O.

Calcium estimation—0·3695 grm. of the dry salt gave 0·0674 grm. calcium carbonate = 7·29 per cent Ca.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2Ca$ ..	512	93·43	—
$2H_2O$	36	6·57	6·81
	548	100·00	
$(C_6H_4BrSO_3)_2$.. ..	472	92·58	—
Ca	40	7·42	7·29
	512	100·00	

Sulphobrom-benzolate of Potassium, $C_6H_4BrSO_2KO$.

The potassium-salt crystallises in well-formed rhombic plates, easily soluble in water. It is readily prepared from a solution of the barium salt by precipitating the barium with potassium sulphate.

Potassium estimation—0·4492 grm. of the salt (at 110°) gave 0·4050 grm. potassium-platinum chloride = 14·01 per cent K.

	Calculated.		Found.
$C_6H_4BrSO_3$ ..	236·00	85·79	—
K	39·11	14·21	14·01
	275·11	100·00	

Isosulphobrom-benzolic Acid, $C_6H_5BrSO_3H$.

In order to obtain this acid, sulphobenzolic acid was first prepared. The acid was freed from water by allowing it to stand for some time over sulphuric acid. It was then introduced into a glass tube, together with about 1½ times its weight of bromine, the tube sealed and subjected for several days to a temperature of 100°. The mass was then dissolved in a small quantity of water, and evaporated on the water-bath, until the evolution of hydrobromic acid ceased. The residue was then dissolved in water, neutralised with lead carbonate, and the lead-salt allowed to crystallise. By decomposing this salt with hydrosulphuric acid, filtering, evaporating, and allowing the solution to stand for some time over sulphuric acid, the free acid was obtained. It is exceedingly deliquescent, and, like the former acid, is monobasic, and forms a series of salts, some of which crystallise well.

(To be continued.)

ERECTING THE INVERTED IMAGE IN THE MAGIC LANTERN.*

By Prof. H. MORTON, Ph.D.

A LENS, as everyone knows, inverts the image which it makes of any object; hence, in the magic lantern, we place the picture upside down, and right for left, in order that its image on the screen may occupy a true position. This is the shortest road out of the difficulty, of course, where it can be followed; but there are many cases in which such a treatment of the subject is inadmissible. Thus, if we wish to exhibit to a large audience the manner in which tacks or iron-filings are vivified by a magnet; how water assumes the spheroidal state on a heated surface; how the same fluid is caused to circulate by local changes of temperature, or is decomposed by a galvanic current; or any of the many similar experiments which may be conducted with striking effect in a lantern: we must resort to some means other than "inversion of the object" to secure an erect or right-side-up position of the image on the screen.

The desirability of some means for reaching such a result is very manifest; and the most natural first-thought is to use a square prism, as described by Brewster in his "Optics" (p. 270), where a drawing is given, curious at once for its theoretical accuracy and practical impossibility,—an equilateral triangle being taken to represent a square prism, and the refracting action indicated as about eight or ten times as great as it could possibly be. Yet, viewed as a symbol or hyroglyph, this drawing, as will be shown presently, may be regarded as embodying actual results, which, if known to the author, were certainly not hinted at, and, to the best of our belief, will find their first publication at this time.

A more accurate drawing of the same thing is to be found in Frick's "Physical Technics" (an admirable work, which should be in the hands of every experimenter and manufacturer of apparatus), p. 209.

* Communicated by the Author.

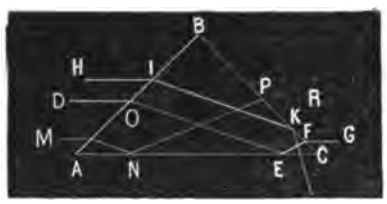
With such authority, we should have proceeded to experiment but for the information, from one who had given much attention to lantern manipulations, that the plan had been tried, and abandoned by him in consequence of the loss of light and reduction of field which it entailed. Prof. R. E. Rogers, who had gone further than we, and had made some experiments, was, we believe deterred from further attempts by the same cause.

A trial, however, was at last made which satisfied us that, under proper conditions, a good result might be realised with a square prism, placed in front of the objective of an ordinary lantern.

The accompanying cut, which is drawn with some attention to accuracy of direction and angle, will show, on inspection, how the upper and under rays, D and M, change places, and thus how the inversion is corrected. In using this prism, no inclination is given to the lantern; it remains directed to the screen, exactly as with the inverted image.

The loss of light experienced is not serious; so that we

FIG. 1.



are able, with an ordinary lantern, to cover a screen of 20 feet in diameter with a brilliant circle of light, while the contraction of field, though notable, is not of any practical inconvenience.

The only drawback was the difficulty and cost of obtaining prisms large enough; and this difficulty has been overcome by the ingenuity of Mr. Zentmayer, who has devised the excellent improvement we shall now proceed to describe.

Observing that with the square prism, only the lower portion is available, any ray above D, Fig. 1, such as H, for example, failing to strike the base and be reflected, but suffering reflection downwards at K, and so being lost, he proposed to make the prism of such a shape as is indicated in Fig. 2.

Here the angle B is calculated to equal the angle of refraction of an horizontal ray, such as D at the surface

FIG. 2.

A B, plus 90°. Under this condition, such a ray, after refraction, would be parallel to the further side, B C, and would therefore reach the base, A E, and be reflected from it, however near to the summit, B, it might strike.

The lower ray, H, would be in an equally favourable condition, as is clear from inspection of the figure.

The angle, B, is 125° 30'; A and C, of course, 27° 15' each. It might be thought that the great obliquity of the surface, A B, would cause a serious loss of light by reflection, but this drawback does not appear in practice.

The economy in thickness of glass required to produce a prism of given effect is decidedly very great. In fact, the ordinary optical glass, which is easily procured, answers perfectly; while for the square prism of sufficient size, it would be necessary to order blocks especially from the foreign manufacturers.

With regard to the curious *symbolism* of Brewster's drawing, we can now explain, that the rays, after refraction, were represented as proceeding in lines parallel with the faces of the prism, as in Fig. 2, though with a triangular, or even with a square prism, this was entirely impossible.

We do not wish to claim any originality in the use of a square prism, as above described, but only to call the attention of those interested to the practicability and success of the arrangement. The form devised by Mr. Zentmayer is, however, we believe, entirely new, and certainly most efficient, and he is entitled to all the credit of its invention. —*Journal of the Franklin Institute.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 19th, 1870.

Dr. WARREN DE LA RUE, F.R.S., Vice-President, in the Chair.

Mr. S. H. Johnson was elected a Fellow.

Mr. GRIFFIN exhibited and explained a new gas-furnace, which is capable of melting about 3 lbs. of iron in little more than one hour.

Mr. WALENN described "*A Method for Coating Cast-Iron Objects, by Electrolysis, with Copper or Brass.*"

The peculiarity of his method consists in the circumstance that no hydrogen is evolved during the process. The following is the prescription of an electrolytic-bath for brass:—A mixture of equal parts of ammonic tartrate and potassic cyanide is saturated with cyanide of zinc and cyanide of copper; and to this solution oxide of zinc and cupric oxide are added. The bath has to be heated, during the process, to about 80°. Several articles (a calico-printing valse, &c.), coated with brass in this manner, were submitted to the inspection of the assembly.

Mr. TOOKEY, Assayer in the Japanese Imperial Mint, communicated a paper "*On the Manipulation of Assays of Gold and Silver Bullion.*"

The number of separate processes, from the first weighing-in of a piece of gold bullion to the second weighing-out, before its value can be ascertained are well known to all assayers. The author had, in connection with the late Mr. Hewny, commenced some operations with the view to treat a batch of assays simultaneously, instead of handling them in rotation and individually, as by the ordinary method. The way pursued by him now is this:—A conical-shaped tube of platinum is closed at its narrower end with a perforated plate; the wider end is provided with a shoulder, so that it can be supported by a porcelain tile having circular holes. The tubes and the holes are numbered, so that each assay can be recognised after the operation. The whole arrangement is then immersed in a vessel containing hydric nitrate (of the proper strength), boiled for the requisite time, &c. In this manner, a great number of bullions may be managed as one assay, and thus a considerable amount of time gained.

A similar reduction in time can also be obtained in the assay of silver bullion by the "dry method." One of the operations in this method is the hammering and brushing of the silver buttons after they have been detached from the cupels. Mr. Tookey employs, instead of this, the following process:—He transfers the silver buttons into the depressed perforated cavities of a platinum plate, fastens each button by means of a handle of platinum wire, and immerses the plate in pure hydric chloride, which is heated until all bone-ash has been dissolved; the plate is then taken out, washed properly, and dried. The cavities of the plate are numbered to correspond with the cupels in the muffle.

Mr. PERKIN read a note "*On some Bromine Derivatives of Coumarin.*"

Bromine combines readily with coumarin, without the evolution of hydric bromide in appreciable quantities; but the product varies according to the manner in which the experiment is performed. The following definite results, however, were obtained:—On adding 1 part of coumarin diffused in carbon disulphide to 1 part of bromine, with several times its bulk of carbon disulphide, the coumarin combines with the bromine; and the compound is, after having allowed the carbon disulphide to evaporate spontaneously, obtained as a crystalline mass, which may be purified by re-crystallisation from alcohol. Crystals thus obtained, dried *in vacuo* and analysed, led to the formula, $C_9H_6O_2Br_2$, which shows it to be dibromide of coumarin. It fuses at about 100°, with partial decomposition; and, when further heated, gives off bromine. It is easily soluble in alcohol: this solution is decomposed by heating or exposure to sunlight.

When a mixture of 2 parts of bromine and 1 part of coumarin in carbon disulphide is heated, in a sealed tube, to about 140° for a few hours, a crystalline product is obtained on cooling, and large quantities of hydric bromide are given off on opening the tube. The crystalline substance is separated from the carbon disulphide, and dissolved in boiling alcohol, from which it crystallises out again on cooling. Analysis showed it to be, $C_9H_4Br_2O_2$; that is, coumarin with two of its hydrogen replaced by bromine,—dibromocoumarin. It fuses at 174°, and distils unchanged; it dissolves in boiling alcohol, from which it crystallises in needles. The alcoholic mother-liquor from dibromocoumarin contains a second body, which can be obtained by evaporating off part of the spirit, and re-crystallising the product for several times. The numbers obtained in the analysis agree with the formula $C_9H_5BrO_2$; it is, therefore, bromocoumarin. It fuses at 110°, is more soluble in alcohol than the preceding body, and forms beautiful curved crystals. Both the bromo- and the dibromocoumarin, when boiled with aqueous potassic hydrate, yield potassium-salts of new acids—probably bromo- and dibromocoumaric acids.

Dr. DIVERS gave some remarks "*On the Precipitation of Solutions of Ammonium-Carbonate, Sodium-Carbonate, and Ammonium-Carbamate by Calcium-Chloride.*"

The results of these experiments are chiefly of interest as supplying a characteristic reaction for the carbamate. If, to an aqueous solution of NH_3 and CaCl, a very little of a dilute solution of ammonic carbonate is added, a gelatinous precipitate forms, which soon dissolves, but, after a short time, again re-appears, and assumes a chalky condition. If a somewhat larger quantity of the dilute solution of ammonic carbonate is taken, the precipitate formed at first is permanent. In both cases, however, it takes days till the precipitation is so far complete that the supernatant liquid no longer gives any precipitate on being heated.

Sodic carbonate, under similar circumstances, behaves like ammonic carbonate. If, to a solution of CaCl, which contains no ammonia, some ammonic carbonate is added, the precipitation of the calcic carbonate is very soon completed; already, after one hour, the supernatant fluid fails to give any precipitate on being boiled. It appears, therefore, that caustic ammonia acts here as retarding the precipitation of calcic carbonate.

If a little of a solution of ammonic carbamate (which was obtained by distillation) was added to excess of CaCl, a slight precipitation ensued at once. The supernatant fluid still gave, after two hours, a slight precipitate on being heated, but did no more after four hours. The supernatant liquid, in the case of ammonic carbonate, would have failed to produce any precipitate after the lapse of one hour.

If ammonic carbamate was added to CaCl in the presence of caustic ammonia, a slight precipitate appeared only after eight hours; and, in days after, the mother-liquor gave still a precipitate on heating. It thus becomes evident that ammonic carbamate soon passes, in the presence of CaCl and in the absence of NH_3, into ammonic carbonate; but the addition of NH_3 impedes such a change.

When ammonic or sodic carbonate is added in excess to CaCl, a chalky precipitate is formed; and, in less than an hour, the filtered solution gives no precipitate when boiled. Addition of caustic ammonia accelerates the precipitation.

It appears thus that ammonia in the presence of ammonic carbonate determines the precipitation of calcic carbonate, instead of impeding it, as it does in the presence of calcic chloride. Sodic carbonate behaves similarly to ammonic carbonate. The distinguishing reaction, therefore, between ammonic carbamate and ammonic carbonate is that, added in excess to ammonia and CaCl, the calcium is precipitated very slowly in the cold by the former, while it is precipitated immediately by the latter.

Dr. THUDICHUM made a short commmunication about having obtained hydric acetate from fresh urine,—a fact contrary to the statements of Berzelius, Lehmann, and Liebig.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor TYNDALL, LL.D., F.R.S., (Lecture II.)

It is necessary to our further progress to have clear and definite ideas as to the character of the magnetic force.

28. The magnetic power of a magnet, or of a magnetic needle, though really distributed throughout its mass, appears to be concentrated at two points near the ends. These points are called the *poles* of the magnet or needle.

29. The magnetic power of the earth is, doubtless, also distributed through the mass of the earth, but a concentration similar to that just noticed endows the earth also with magnetic poles.

30. The action of the earth upon a magnetic needle is this; the north terrestrial pole repels one end of the needle and attracts the other; the south magnetic pole also attracts one end of the needle and repels the other. But the end attracted by the north terrestrial pole is repelled by the south, while the end attracted by the south is repelled by the north.

31. Thus to each terrestrial magnetic pole the needle presents two ends which are differently endowed. Two opposite kinds of magnetism may be supposed to be concentrated at the two ends. In this *doubleness* of the magnetic force consists what is called *magnetic polarity*.

32. Each of the two distinct kinds of magnetism may be regarded as self-repellent. North repels north, and south repels south. But different kinds of magnetism are mutually attractive; south attracts north and north attracts south.

33. When a magnet, or magnetic needle, is suspended with the line joining its poles *oblique* to the magnetic meridian, the earth's action on the needle resolves itself into what in mechanics is called "a couple," tending to turn the needle into the magnetic meridian.

34. When the needle is in the meridian, the two forces which constitute the couple are equal and opposite. The tendency to produce rotation then ceases; the needle is in its position of equilibrium.

35. When the forces are equal and opposite they must neutralise each other; no *motion of translation* of the needle being, therefore, possible. Thus, when the needle is caused to swim on water, or on mercury, it does not move towards either of the terrestrial magnetic poles.

36. One pole of a bar magnet repels the one end and attracts the other end of a magnetic needle. At the other pole of the magnet the attraction and repulsion are reversed. In the middle of the magnet is the *magnetic*

equator, where neither end of the needle is attracted or repelled.

37. An electro-magnetic helix, even without a core of iron, behaves exactly like a magnet. It attracts iron. Its two ends, moreover, are opposite poles, and between them is a magnet equator. When, however, a core is placed within the helix, the magnetism of the combined system is far more intense than that of the helix alone.

38. The strength of a magnet is measured by its power to deflect a magnetic needle from its meridian; the magnetic strength of a helix alone, and of a helix and core combined, are similarly determined.

39. To obtain the magnetic strength of the core alone, we first determine the strength of the helix alone, then that of the helix and core combined; subtracting the former strength from the latter, we obtain the magnetic strength of the core.

40. If the cores be thick and formed of good iron, the magnetic strength of the core is exactly proportional to that of the helix. A helix of double power will produce an electro-magnet of double strength; a helix of treble power, an electro-magnet of treble strength, and so on. Thus by varying the strength of the helix we vary in like degree the strength of the iron core within it.

41. And here an important point arises. When we allow a core of double power to act upon a piece of good iron, nearly, but not quite in contact with the core, the attraction of the iron is not doubled, but quadrupled. If the core be of treble power, the attraction is not only trebled, but it increases ninefold. If the magnetic strength of the core be quadrupled, the attraction of the iron is augmented sixteenfold. In fact, the attraction is proportional, not to the strength simply, but to the strength multiplied by itself, or to the *square of the strength* of the electro-magnet.

We must be very clear as to the cause of this action, and must, therefore, contrast for a moment the magnetic action of hard steel with that of soft iron.

42. Soft iron is easily magnetised, but it loses its magnetism when the magnetising force is withdrawn. Steel is magnetised with difficulty, but it retains its magnetism even after the withdrawal of the magnetising magnet.

43. This obstinacy on the part of steel in declining to accept the magnetic state, and this retentiveness on the part of steel when the magnetic condition has been once imposed upon it, are called *coercive force*. It is not a happy term, but it is the one employed.

44. Supposing a piece of magnetised steel to possess a coercive force so high as to resist further magnetisation, its attraction by an electro-magnet would be directly proportional, not to the square of the strength but simply to the strength of the electro-magnet.

45. Why, then, does the iron follow the law of the square of the strength? It is because the magnetic condition of the iron is not constant, but rises with the strength of the magnet. When the magnetism of the core is doubled, the magnetism of the iron is also doubled. When the magnetism of the core is trebled, the magnetism of the iron is trebled. The resultant attraction is found by multiplying the magnetism of the iron by the magnetism of the core; and this product is the expression of the law of squares just referred to.

46. To make the matter clearer, let us figure the magnetism of the core as due to particles of magnetism, which are introduced into the core in gradually-increasing numbers. Let us start with a core possessing one magnetic particle, and let it act upon a piece of hard steel, also possessing one magnetic particle: the resulting attraction will be unity or 1. Let two particles be now thrown into the core: the steel, in virtue of its coercive force, remains unchanged, but its particle being now pulled by two particles instead of one, the resulting attraction will be 2. If three particles of magnetism be thrown into the core, all of them pulling at the single particle of the steel will produce a treble attraction, and so on.

47. Now let us start with a core possessing, as before, a single particle of magnetism, and with a piece of iron also possessing a single particle generated by the core: the attraction, as before, is here unity. On introducing two particles into the core, they generate immediately two particles in the iron. But two particles, each pulled by twice the force first exerted, makes the attraction four times what it was at the outset.

It is to be remembered that every particle is attracted as if the other particles were absent.

48. In like manner, if three particles be thrown into the core, three particles are also generated in the iron. Each of these iron magnetic-particles is pulled by the three particles of the electro-magnet; that is to say, each of the iron particles is pulled with three times the primitive force. But there are three particles so pulled; hence the attraction is nine times what it was at the outset.

49. Let us compare this action for a moment with that of gravity. Two masses of matter attract each other with a force which we shall take as our unit. If the one mass be doubled, the attraction is doubled; if both masses be doubled, the attraction is increased fourfold. If one mass be trebled, the attraction is trebled; if both masses be trebled, the attraction is increased ninefold. When, therefore, both the masses are doubled and trebled, we have the law of squares. Now, it is this doubling and trebling, *in both cases*, of the thing which causes magnetic attraction which causes it to follow the same law.

50. Why do I lead you through these considerations? Simply to make clear to you that, if "the law of squares" here developed shows itself in the action of a magnet upon matter, we may infallibly infer that the condition of that matter is not a *constant condition*, but that it rises and falls with the condition of the magnet. Matter thus affected is said to be magnetised by influence or by induction: it is attracted or repelled (for we shall come immediately to the repulsion of matter by a magnet) in virtue of some condition into which it is temporarily thrown by the influencing magnet.

51. What, then, is the thing that causes magnetic attraction? The human mind has long striven to realise it. Thales (600 B.C.) thought that the magnet possessed a soul. Cornelius Gemma, in 1535, supposed invisible lines to stretch from the magnet to the attracted body—a conception which reminds us of Faraday's lines of force. Cortes di Lodi thought the iron the natural nutriment of the magnet. Descartes embraced magnetic phenomena in his celebrated theory of vortices; and, in our day, Clerk Maxwell has worked in this direction. Æpinus assumed the existence of a magnetic fluid. Coulomb assumed the existence of two fluids, each self-repellent, but mutually attractive. Ampère deemed a magnet an assemblage of minute electric currents, which circulated round the atoms of the magnetised body. These conceptions are sometimes exceedingly useful as a means of connection and classification, even when we do not believe them true. William Thomson deduces magnetic phenomena from "imaginary magnetic matter;" thus giving the mind the conception while distinctly releasing it from belief. The real origin of magnetism is yet to be revealed.

52. Brugmans, in 1778, first observed the repulsion of bismuth by a magnet. In 1827, Le Baillif described the repulsion of antimony. Saigey, Seebeck, and Becquerel also observed certain actions of the kind.

53. In 1845, Faraday generalised these observations by demonstrating the magnetic condition of all matter. He showed that bodies divided themselves into two great classes, the one attracted, the other repelled by the poles of a magnet.

54. To the force producing this repulsion Faraday gave the name of diamagnetism.

What is the nature of this force? Is it inherent and constant? or is it induced?

55. The repulsion of diamagnetic bodies follows accurately the law of squares above developed. A double force produces a quadruple repulsion; a treble force produces a ninefold repulsion, and so on.

56. Hence we may infer with certainty that the condition of diamagnetic bodies, in virtue of which they are repelled by a magnet, is a condition induced by the magnet, rising and falling as the strength of the magnet rises and falls.

57. The force of diamagnetism is vastly feebler than that of ordinary magnetism. Of all diamagnetic substances, for example, bismuth is the most strongly repelled; but its repulsion is almost incomparably less than the attraction of iron. According to Weber, the magnetism of a thin bar of iron exceeds the diamagnetism of an equal mass of bismuth about two and a half million times.

58. Diamagnetic bodies under magnetic excitement exhibit a polarity the reverse of that of magnetic bodies. In all cases whether we operate with helices or with magnets, or with helices and magnets combined, the actions of magnetic and diamagnetic bodies are antithetical.

59. An iron statue standing erect on the earth's surface is converted into a magnet by the earth's magnetism; a marble statue, or a man standing erect, is converted by the same force into a diamagnet; for marble is diamagnetic, and so are all the tissues and all the solids and fluids of the human body. The poles of the man are those of the iron statue reversed.

60. Organic bodies, and most crystals, are magnetised with different degrees of intensity in different directions. They are endowed with *axes* of magnetic induction.

61. Thus in the case of Iceland spar (carbonate of lime), the *repulsion* along the axis is a maximum. In the case of carbonate of iron, a crystal of the same shape and structure as carbonate of lime, the *attraction* along the axis is a maximum.

62. The position assumed by a crystal when suspended between the poles of a magnet, depends on its magnetic axes.

Erratum.—In note 20, line 5, for "lay" read "lie" (Chemical News, vol. xxi., p. 211).

CORRESPONDENCE.

ANALYSIS OF WATER—STATEMENT OF THE RESULTS.

To the Editor of the Chemical News.

Sir,—In the *Journal of the Chemical Society* which is this day to hand, are printed, *in extenso*, the papers read at the Society's ordinary meeting of the 7th of April, and amongst them is that of Professor How, "On an Acid Feed-Water from the Coal-Field at Stellarton, Nova Scotia, and the Results of its Use," which called forth some remarks from myself and others on the occasion of its being read.

The peculiarity herein noted is one sometimes met with in the coal and iron districts of Great Britain, and consists in the occurrence of ferrous salts and small proportions of free sulphuric acid (derived from the oxidation of pyrites) in the mine-water, which has commonly to do duty in the steam-boilers of engines working near the pit's mouth. The "results" are, extensive corrosion of the plates and the formation of ferruginous deposits, both of which, as I pointed out, could be very easily remedied by the use of lime, caustic soda, or other alkali, introduced into the boiler.

There are, however, one or two anomalies in the paper, which seem to have escaped the attention of the author, as well as of the gentlemen composing the "committee of publication" of the Society's journal. These points I will briefly mention. At pages 157 and 158 are specified the results obtained by the analysis of the objectionable "pond-water" and "well-water"; and in these tables it will be seen that the constituents are arranged in a somewhat anomalous manner—thus, besides other ingredients, there are, in grains per gallon—

	Pond.	Well.
"Sulphate of potash..	1·53	6·44
Chloride of sodium	0·28	0·40
Chloride of potassium	0·67	0·88
Free sulphuric acid (oil of vitriol)	1·92	0·43"

In the absence of interfering causes, what circumstances can be assumed to have limited the formation of sulphate of potash to the amounts stated on the first line? Instead of vitriol and alkaline chlorides, why not free *hydrochloric* acid in the water?

Again, at page 159, there are two analyses of boiler deposits given, in each of which "peroxide of iron and a little alumina" are stated to be contained in aggregate proportions, amounting to 54 and 13 per cent respectively. But whence this alumina, since the feed-waters contain none? No mention is made of the existence of alumina in either of the columns specifying the results of the water analyses; silica *is* there in small quantity, but it is not accounted for in the deposits.

In another place, we are told that "the pond rests upon the measures immediately *underlying* the acadia seam of coal." This must surely be a misprint, for the water was affected by the frost.—I am, &c.,

John Spiller.

London, May 24th.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—I hasten to disabuse the mind of "Scrutator" of his impression that I lay claim to any originality, either in regard to the volumetric solution named by me, or the mode of marking the termination of the reaction with potassium chromate. I imagined that both these were too well known amongst chemists to make it necessary to mention specially that they were in use at present. Certainly, had I supposed that either were of my own discovery, I should not have called my suggestion "a slight modification of the ordinary volumetric process." I cannot, with "Scrutator," regard an error of 0·1 grain of chlorine on the gallon as of serious importance from a sanitary point of view.—I am, &c.,

Thos. P. Blunt.

MISCELLANEOUS.

Effects of the Sun's Heat on a Sand Hill.—Extract from a letter of G. Davidson, Esq., of the Coast Survey, dated U. S. Coast Survey Station, San Buenaventura, Cal., January 23, 1870 (communicated to *Silliman's Journal*, by Mr. D. B. Smith, of Germantown, Pa.):—I have had a very curious experience at this station. It is on the edge of a sandy, steep bluff, seventy feet above the low flat margin that extends 300 yards to the sea beach. At the station, I had an 18 inch theodolite, with three reading microscopes, and was engaged in determining the azimuth of the principal lines of the triangulation from the station San Buenaventura. This involved observations from sunrise to 10 a.m., and from 3½ p.m. to 11 p.m. Imagine my surprise when I found that the heat of the sun pouring all the P.M. upon the south-west face of this bluff so expanded it that the level showed changes as great as 45"! Then in the evening contraction began, and continued until the level at sunrise exhibited changes of 45" the other way. Here

was a change of 1′ 30″ certainly due to changes of temperature; our lowest temperature was about 40°; our greatest about 79° in the shade, say, 100° in the sun. But this is not all: I was dismayed to find that in cooling during the evening, the tongue of the bluff upon which the station is situated, twisted irregularly in azimuth as much as 18″ in three hours. This, of course, vitiated all my results, and I continued a full series simply as an experiment, for I could not change my position for an eccentric one without many drawbacks. I did change my latitude instrument and transit from their positions near the station, and where the same phenomena were exhibited by them. At 102 yards from the edge of the bluff they are as steady as a rock, and I have nothing but the excessive undulations of the heated air to contend with.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, May 16, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Solid Cresol.—A. Wurtz.—300 grms. of toluen are first converted into cresyl-sulphurous acid, the potassa salt of that acid having been fused in a silver vessel with a mixture of potassa and soda, is afterwards decomposed by hydrochloric acid, yielding 200 grms. of crude cresol boiling at between 198° and 204°. On cooling the distillate to a very low temperature, a solid substance was obtained, which, after having been purified by pressing between folds of blotting-paper, and washing with a little ether, is a white crystalline substance exhibiting a strong smell of phenol. It fuses at 34·5°; and if, while in state of fusion, it is simply touched with a piece of solid cresol, it at once again becomes solid. It boils at 201·5°.

Observation made by Laundresses on the South Coast of Spain.—M. Guyon.—The author first states that, when the *bochoro* (a southerly wind) blows, the experience of a series of past years has proved, to the laundresses of the country referred to, that the linen always assumes a yellowish hue when hung up for drying or laid down on the grass for the purpose of bleaching. This curious effect is due, the author says, to the fact (also frequently observed in the south of France, along the coast of the Mediterranean) that a southerly wind is almost always accompanied by, or rather the carrier of, a yellowish dust, brought over from the African sandy deserts. There appears, then (that is to say, on such days as the southerly wind blows), to be a kind of mist, or fog, which the late Baron Cloquet, while residing at his country seat at Fort Lamalgue, near Toulon, describes as dry and decidedly dusty. Sailors on board vessels in the Mediterranean are often seriously affected with conjunctivitis, in consequence of being exposed to this dust. It should be borne in mind that the great African desert reaches, in Tripoli, the sea coast, constituting there an extensive sandy beach.

Use of Milk as Preservative against Lead Poisoning.—M. Didierjean.—The author, a red-lead manufacturer, states that, having taken all possible precautions to keep their workmen in healthy state, he did not, however, quite succeed in preventing lead colics until, by a mere accident, it was found that two of their men were never affected at all. On inquiry being made, it turned out that they regularly took milk as drink at the time of taking their meals at the works. The owners of the works were thus induced to make the use of milk (1 litre daily) obligatory for their workmen while at the works; and, by exercising a proper surveilance, have succeeded, during eighteen months, of keeping, by this means, all their men free from any symptom of lead disease. The author states that he does not wish to exaggerate, but he vouches for the absolute correctness of his communication.

The Paris Basin in Pre-Historic Days.—M. Belgrand.—A lengthy and very interesting geological paper.

Theory of the Tides.—M. Roumiantzoff.

Remarks on the Spectrum of Nitrogen.—Lecoq de Boisbaudran.

Maximum of Density and the Freezing-Point of Solutions of Alcohol in Water.—F. Rossetti.—The mixing of alcohol with water has the effect of bringing the point of maximum density and of freezing of such a mixture nearer to each other; and in a solution containing 14·4 per cent of alcohol, the freezing-point, −7·35°, coincides with that of maximum density.

Application of Silicate of Potassa for the purpose of Solidifying Fossil Bones.—M. Farez.—The author applies a concentrated (syrupy) solution of silicate of potassa, in order to lessen the risk of breakage and obviate the porosity of fossil bones to be preserved as specimens in collections.

Knowledge Possessed by Men of Science concerning Magnetism in the 13th Century.—M. d'Avezac.—By the study of ancient manuscripts found in the library of the Arsenal at Paris, and carefully collated with facsimiles of these manuscripts extant at Leyden, the author concludes that the phenomena of magnetic declination were already known in the 13th century.

Composition of the Gas of the Fontaine Ardente of Saint-Barthélemy (Isère).—F. M. Raoult.—This so-called fountain is the issuing out of the soil of inflammable gas at or near the locality above-named, situated at 25 kilometres south of Grenoble. The author, on visiting this spot, found the gas issuing out from a multitude of fissures in a schistose rock, and burning in some parts. The gas is devoid of smell; it contains, in 100 parts, by bulk—Carbonic acid, 0·58; nitrogen, 0·48; oxygen, 0·10; marsh gas (CH_4), 98·81; loss, 0·03.

Note on the Detection of Ammonia and Nitric Acid by means of Rosolic Acid and Bromo-Mercurate of Potassa.—P. Guyot.—Only the title of this paper is quoted.

Bulletin Mensuel de la Société Chimique de Paris, April, 1870.

From the *procés-verbaux* of the meetings of this Society, we learn that, when chloral acts upon aniline, there is formed $C_{30}H_{21}NO_4$. The author, M. Maumené, states that this is an energetic base, soluble in acids, but not yielding crystalline salts.

M. Salet describes an arrangement whereby the detection of sulphur and phosphorus, spectroscopically, is rendered more perfect by causing the flame of hydrogen to be reflected by water running along a bright piece of platinum.

M. Bourgoin states that the accident which took place some time ago in the laboratory of the Hôtel-Dieu (see Chemical News, vol. xxi., p. 191) was solely due to a bad arrangement of the apparatus in use, and, more yet, to the proportion of the chlorate of potassa and peroxide of manganese. The author says, when equal parts, by weight, of these substances are mixed, the gas is regularly given off, and no fusion takes place; but, if only one-half of peroxide be used, fusion will take place, and there will be a sudden evolution of gas with explosive force.

The following original papers are contained in this number:—

Thermo-Chemical Researches on Bodies formed by Double Decomposition.—MM. Berthelot and Longuinine.—This very lengthy memoir is sub-divided as follows:—Method; acetic chloride, $C_4H_3ClO_2$; acetic bromide, $C_4H_3BrO_2$; acetic jodide, $C_4H_3IO_2$; butyric bromide, $C_8H_7BrO_2$; anhydrous acetic acid, $(C_4H_3O_2)_2$; formation of anhydrous acids; formation of acid chlorides.

Laws which Regulate the Division of a Substance between Two Solvents.—MM. Berthelot and Jungfleisch.

Laws which Regulate the Division of a Substance between Two Solvents.—M. Berthelot.—The first of these memoirs contains the lengthy description of the experiments, and the second paper the theory deduced therefrom.

Researches on the Condition Salts are in when in Solution.—MM. Berthelot and L. de Saint-Martin.—This memoir contains the following chapters:—Acid salts in solution; division of acids between one and the same base.

Preparation of Pure Nitrogen.—M. Berthelot.—Take a bottle or flask of from 10 to 15 litres' capacity; place at the bottom some 200 grms. of pure copper turnings, and pour over these, so as to cover the metal partly, a quantity of liquid ammonia. The bottle is closed by means of perforated cork, fitted with a safety-tube and gas delivery-tube, which latter is, however, closed by means of a caoutchouc tube, shut off with a spring clip. The bottle so arranged is left standing for some days, care being taken to shake up its contents. The oxygen of the air contained in the bottle is completely absorbed, and the pure nitrogen may be readily transferred to another vessel.

Reaction of Phenol upon Ammonia.—M. Berthelot.—The author states that, contrary to the general opinion on this subject, his researches, expressly instituted to illustrate this matter, have proved that, under no conditions, ammonia, or compounds thereof, yields any aniline when heated with phenol in sealed tubes.

Distillation of Super-Heated Liquids.—M. Berthelot.

Action of Perchloride of Phosphorus upon Iodoform.—A. Gautier.—The main result of this reaction is the formation of chloroform—

$$2CHI_3+3PCl_5=2CHCl_3+I_6+3PCl_3.$$

Properties of Iodic Acid.—A. Ditte.—This lengthy memoir is divided into the following sections:—Anhydrous iodic acid; hydrated iodic acid. The author describes, at great length, the preparation, properties, and all reactions of these substances.

Revue des Cours Scientifiques de la France et de l'Etranger, May 7, 1870.

Although this number does not contain any papers or memoirs specially devoted to chemistry or collateral sciences, the following paper—

Scientific Work done in the Departments of France—E. Blanchard—Contains particulars which we briefly quote here. Alluding, in the first place, to a long-disputed question—to wit, the alleged identity of composition of all the sulphurous mineral waters met with on the Pyrenees (French side)—the author states that the very careful researches of Dr. Filhol, of Toulouse, have proved the fact that some of these waters, while impregnated with sulphuretted hydrogen, contain an exceptionally-large proportion of carbonate of soda, whereby they are quite alkaline; while others, again, which are very prone to decomposition, contain sulphuretted hydrogen in a peculiar state; lastly, some of these waters contain an abundance of *baregine*, a peculiar organic matter. To Dr. Filhol, also, is due the initiative of exploring some of the caverns of the Ariège, and especially the cave of Herm. These labours have brought to light several important facts relating to primitive man, and to such now extinct animals as the *Felis spelæa* and *Ursus spelæus*. The author of this paper speaks highly, and describes, at great length, the very assiduous labours of Dr. P. Rouville, at Montpellier, in reference to an excellent geological map of the Département de l'Hérault (a most interesting part, not only of France, but, generally speaking, for geological discoveries); while the mining engineer, Mallard, has worked in a similar direction for the departments of the Haute-Vienne and Creuse. To both the gentlemen just named, as, also, to M. E. Dumortier, who has likewise excelled in geological labours relating to the right bank of the Rhone and Jura districts, silver medals have been given by the Geological Society of France.

No. 24, 1870:

The Science of Life.—Dr. W. Kuhne.—A verbatim, but translated report of the author's lecture at the inauguration of a physiological laboratory in connection with the Athenæum at Amsterdam. We regret that the length of this excellent paper does not admit either its abstraction or full reproduction.

Parasites of and on the Cereals: Ergot of Rye.—E. Fournier.—A lecture on this subject, containing a large amount of useful information.

Composition of the Air (Gas, rather) Given Off by a Chaufer containing Ignited Charcoal.—Dr. C. Bernard.—The author, while continuing his lectures on asphyxia by vapours of burning charcoal, quotes the following analysis, by Dr. Leblanc, of the gas above named, containing, in 100 parts—Oxygen, 19·79; nitrogen, 75·02; carbonic acid, 4·61; oxide of carbon, 0·54; carburetted hydrogen, 0·04;—total, 100.

Revue Hebdomadaire de Chimie, May 5, 1870.

Apparatus for the Prevention of Steam-Boiler Explosions.—O. Zabel.—The author gives, as a theory for the cause of these explosions, a superheating, accompanied by a peculiar stagnation of the water in the boilers; and says that, when such a condition occurs, a very slight cause—for instance, even the starting of the engines—may cause a motion in the water, which, being super-heated, is thereby suddenly converted into steam of very high pressure, thus causing the explosion. The apparatus, described at length, is intended to remedy the stagnation of the water, and its consequent super-heating, by keeping it in motion.

Centrifugally-Acting Rag-Washing Machine.—W. Ralp.

Preparation of Sea-Weed, and its application to the Manufacture of Paper.—J. E. Brizot.—It is rather difficult to make out what kind of sea-weed the author refers to, and this the more so as there are several different species of these plants, and some specifically belonging to the Mediterranean, on the shore of which the author's residence (Toulon) is situated. From the description given, we presume the *Laminaria digitata* is alluded to; and this weed is largely found in some portions of the seas surrounding the British Isles. The weed is washed, the bark, or skin, is removed, as far as necessary, and, thus prepared, placed in dilute sulphuric acid for the purpose of softening the weed, after which it is bleached and made into pulp.

Ciment Lapidifique Hydrofuge.—Under this name, MM. Camus and Sons, 2, Rue Barbette, Paris, have for sale a substance, not specified as to its composition, but very highly recommended for its qualities of curing and preventing dampness of walls; and the colour of this material, a bright grey, is such as not to require painting or papering of walls covered with it.

New Method for the Preservation of Meat.—The process here described may be summarised thus:—The beasts are killed by causing them to inhale carbonic oxide. As soon as they have become thereby insensible, they are bled; the operations after the killing of the animal are performed as usual. The meat is next exposed in a peculiarly-constructed vessel to an atmosphere composed of nitrogen and oxide of carbon, and afterwards placed in a box over a mixture of sulphurous acid and charcoal. This is Mr. Gamgee's process.

Cosmos, May 14, 1870.

Meteorological Prognostics for 1870.—Dr. Chapelas-Coulvier-Gravier.—From this paper we quote that, according to the author's scientific investigations, extending some years back, and for sound reasons, based on a series of observations, the temperature this year will be moderate, while rain and dry weather will be successively experienced. There will be no excessive drought. Thunderstorms will be frequent, and, on the whole, the season will be as that of 1862.

Although not exactly belonging to the subjects usually treated of in our paper, we call attention to the following:—

Important Archæological Discoveries in the Ancient Gaulic Cemetery near Chassemy (Aisne).

Peculiar Substance Fallen in the shape of Rain at Genoa on the 14th of February last.—G. Bocardo.—The material alluded to consisted, in 100 parts, of—Water, 6·490; organic nitrogenised matter, 6·611; sharp sand, mixed with a small quantity of clay, 65·618; oxide of iron, 14·692; carbonate of lime, 8·589. The author also gives the results of his microscopical investigations on this subject, finding the powder to contain several sporulæ of cryptogamic plants, and a substance akin to starch in structure, at least as to the origin of this dust. The author speaks very reservedly, reminding his readers that, according to Captain Maury's observations (as in 1846), dust may blow even across the Atlantic towards the Azores and Southern Europe.

Anthropophagi of Chauvaux.—Dr. Spring.—The author relates, at length, his discoveries in the cave of Mount Chavaux, Namur, Belgium, and proves that, at a remote period of man's existence, anthropophagism was very common. This paper is interesting also for the history of primitive man.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, February, 1870.

The only papers relating to chemistry of this number are—

Preparation of Ethylamines on the Large Scale.—Prof. A. W. Hofmann.

Desulphuration Products of Diphenyl-Sulphocarbamide.—Prof. A. W. Hofmann.—Both these papers are too much condensed already to admit of any useful abstraction.

Journal für Praktische Chemie (double number), Nos. 4 and 5, 1870

This number contains the following original papers and memoirs:—

On the Haloid Compounds which Correspond to Picric Acid and Dinitrophenol, and some Derivatives thereof.—Dr. C. Clemm.—In addition to a lengthy introduction, this memoir contains the following sections:—Action of pentachloride of phosphorus on picric acid; preparation of trinitro-chlorobenzol; trinitro-chlorobenzol and ammonia; trinitro-chlorobenzol and aniline; trinitro-chlorobenzol and ethyl-aniline; trinitro-chlorobenzol and phenol-sodium; trinitro-chlorobenzol and rhodan-potassium; dinitrophenol and phosphor-pentachloride; dinitro-chloro-benzol and ammonia; conversion of dinitro-bromobenzol into dinitro-phenol and into dinitraniline; dinitro-bromobenzol and aniline.

Some of the Derivatives of Mercuro-Diphenyl, Mercuro-Ditolyl, and Mercuro-Dinaphthyle.—R. Otto.—This paper treats on acetic acid mercuro-monophenyl; nitric acid mercuro-monophenyl; carbonic acid dimercuro-monophenyl; behaviour of mercurous chloride with mercuro-diphenyl; mercuro-monophenyl-cyanide; mercuro-monophenyl-sulphocyanide—

$$\left.\begin{matrix} C_6H_5 \\ CN-S \end{matrix}\right\} Hg;$$

mercuro-monophenyl-hydroxyl—

$$\left.\begin{matrix} C_6H_5 \\ HO \end{matrix}\right\} Hg;$$

mercuro-monotolyl-chloride—

$$\left.\begin{matrix} C_7H_7 \\ Cl \end{matrix}\right\} Hg;$$

mercuro-mononaphthyl-chloride—

$$\left.\begin{matrix} C_{10}H_7 \\ Cl \end{matrix}\right\} Hg;$$

myristinic acid mercuro-monophenyl—

$$\left.\begin{matrix} C_6H_5 \\ C_{14}H_{27}O-O \end{matrix}\right\} Hg.$$

On Madder.—Dr. A. Petzhold.—This highly interesting paper contains the tabulated results of the ash analyses of no less than thirteen samples of madder—viz., five samples from Zeeland, and the rest from the Vaucluse.

On a Rapidly-Executed and Correct Method for the Quantitative Estimation of Nitric Acid in the Potable Waters of Bâsle, Switzerland.—Dr. Goppelsroeder.—From the appendix to this rather lengthy memoir, we learn the following about the quantity of nitric acid contained in a litre of snow fallen on the following days of this year:—February 8th, 0·002 grm.; Feb. 12th, 0·0017, and later same day, 0·002; Feb. 21st, 0·002, and later same day, 0·0072; Feb. 22nd, 0·002; March 4th, 0·0016.

Conversion of Starch by so-called Diastase of Malt.—Dr. A. Schwarzer.—A lengthy treatise on this subject, containing the results of a number of experiments on the large as well as the small scale.

On Glaucopyrite.—Dr. F. Sandberger.—This mineral, newly discovered, has a specific gravity of 7·181; its formula is—

$$FeS_2+12\left.\begin{matrix} Fe \\ (CO) \\ (Cu) \end{matrix}\right\} As_2 \atop (Sb)_2.$$

It contains, in 100 parts—Sulphur, 2·36; arsenic, 66·90; antimony, 5·59; iron, 21·38; cobalt, 4·67; copper, 1·14.

New Derivatives of Aromatic Amido Acids.—P. Griess.—This memoir treats of—Carboxamido-salicylic acid; carboxamido-hippuric acid—

$$C_{10}H_{16}N_4O_7=\begin{matrix}C_7H_4N\\C_7H_4N\end{matrix}\left\{\begin{matrix}H\\C''O\\H\end{matrix}\right.\begin{matrix}\\O_3.C_2H_3(NH_2)O\\O_2.C_2H_2(NH_2)O\end{matrix}$$

Polytechnisches Journal von Dingler, second number for April, 1870.

The first April number, not having come to hand yet, will be quoted afterwards. The above-named number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Improved Attwood's Machine.—C. Oechsle.—This paper is illustrated by engravings. The contrivances, however, are real improvements; and the author, a physical instrument maker, has applied, in an ingenious manner, an electro-magnetic apparatus.

Improvement in the so-called Chamber Method of White-Lead Manufacture.—F. Brammer.—By this process, the lead in thin sheets is exposed, in a properly-constructed room, to the joint but alternate action of the vapours of acetic acid (vinegar) and an atmosphere of pure carbonic acid. The author describes, at great length, his manufactory, arranged according to this plan of preparing white-lead, which has the very decided advantage of yielding an excellent product, and, at the same time, preserving the health of the workmen.

Description of a New Apparatus for the purpose of Replacing the Claying and Liquoring Processes in the Sugar Manufacture and Refining.—Dr. O. Tech.—The author describes his process and apparatus at length. The main principle is that a column of liquid (in this instance, a very concentrated and fine liquor) exercises, when 32 feet high, a pressure of 15 lbs. to the square inch. This principle is made use of with properly-constructed air-tight apparatus to clear the sugar placed in the moulds in a very short space of time, and with a very considerable saving of labour and materials.

Chemical Investigation of Several Samples of Condensed Milk (Preserved Milk).—L. Kofler.—The author has extended his researches over five samples—1, Anglo-Swiss Condensed Milk Company; 2, from Sassin (Prussia); 3, from Vivis (Switzerland); 4, from Kempten (Bavaria); 5, prepared by the author. These samples contain, besides sugar (purposely added to an extent of from 25 to 30 per cent), and milk sugar to from 14 to 18 per cent—

	1.	2.	3.	4.	5.
Water	22·180	18·824	22·421	18·810	20·770
Fatty matter (butter)	12·260	12·625	12·030	13·650	12·830
Caseine and albumine	28·100	24·240	25·960	24·900	29·600
Ash	2·180	2·482	2·673	2·430	2·865

The paper contains a full and lengthy report on these articles, all of which were also submitted to microscopic investigation, and found to be genuine articles, in every respect fit, when diluted with water (in which liquid all these substances were readily soluble in the cold), to be used as milk.

Abbreviated Method of Designating the Measures and Weights of the Metrical System.—J. C. Evers.—The author, Inspector of the Netherlands' Government Telegraph Lines, has introduced at the offices, under his orders, the following simple plan:—Myriametre, MM.; kilometre, KM.; hectometre, HM.; decametre, DM.; metre, M.; decimetre, dM.; centimetre, cM.; millimetre, mM.; square kilometre, KM_2.; square metre, M_2.; square centimetre, cM_2.; stère, or cubic metre, S. or M_3.; cubic centimetre, cM_3.; cubic millimetre, mM_3.; kilolitre (1000 litres), KL.; hectolitre, HL.; kilogramme, KG.; gramme, G.; decigramme, dG.; centigramme, cG.; milligramme, mG.

Annalen der Chemie und Pharmacie, VII. Supplementband, No. 2, 1870.

This number contains the following original memoirs and essays:—

Researches concerning the Iodated Salicylic Acids: Oxysalicylic Acid and Hypogallic Acid.—Dr. P. Liechti.—This very extensive memoir is divided into the following sections:—Preparation of iodsalicylic acids; mono-iodsalicylic acid—

$$C_7H_5IO_3=C_6H_3I\left\{\begin{matrix}COOH\\OH\end{matrix}\right.$$

di-iodsalicylic acid—

$$C_7H_4IO_3=C_6H_2I_2\left\{\begin{matrix}COOH\\OH\end{matrix}\right.$$

oxysalicylic acid—

$$C_7H_6O=C_6H_2\left\{\begin{matrix}COOH\\2OH\end{matrix}\right.$$

opinic and isopinic acids.

Preliminary Notice on some of the Acids which are generated from Salicylic Hydride.—Dr. Städeler.

Action of Hydrogen upon Perchloride of Methan.—Dr. Städeler.

Dichloride of Phenol, Dichloronitro-Phenol, and Dichloramido-Phenol.—Dr. F. Fischer.

On Chloronitrophenols.—A. Faust and E. Saame.

Orthonitro-Dichlorphenol and an Isomeric Dichlorphenol.—O. Seifart.

Reduction of Nitrobenzol by means of Hydrobromic and Hydrochloric Acids.—Dr. H. Baumhauer.—This memoir contains the following sections:—Action of hydrobromic acid upon benzol; action of hydrochloric acid upon nitrobenzol.

Description of an Improved Gas Furnace for Elementary Organic Analysis.—C. Glaser.—Illustrated by lithographs.

Formation of Iodoform, and Application of this Reaction to Chemical Analysis.—A. Lieben.

Mode of Transit of Alcohol into the Urine.—A. Lieben.

VII. Supplementband, No. 3, 1870.

This number opens with the very lengthy memoir on—

Anthracen and Alizarin.—C. Graebe and C. Liebermann.—We can here only quote the chapters of this memoir—Anthracen; hydrides of anthracen; bromine derivatives of anthracen; chlorine derivatives of anthracen; anthrachinon and substituted anthrachinones; alizarin; purpurin; pseudo-purpurin; chrysophanic and chrysamminic acids; constitution of anthracen and its derivatives.

The Avogadro Law, as Derived from the Mechanical Gas Theory.—A. Naumann.

On the Avogadro Law.—K. Zöppritz.

Nature of the Chemical Elements as a Function of their Atomic Weights.—L. Meyer.—Illustrated by lithographs.

Journal für Gasbeleuchtung, April, 1870.

Contains—

Normal Flames for Photometric Use.—Dr. Schilling.—A series of figures.

Tar as Fuel in Gas-Works.—H. Raupp.—Illustrated with engravings.

Water Supply and Water-Works of the Town of Brunswick.—W. Claus.—A very complete description and review of this matter.

Brief Notes on the Water Supply and Water-Works of German Towns.—Dr. Schilling.

NOTES AND QUERIES.

Indigo-Carmine.—(Reply to "J. D. S.")—Consult the works mentioned in our issue of the March 11th last, under the heading "Colours and Pigments" (p. 120); also Cooley's "Cyclopœdia of Practical Receipts," published by Churchill.

Self-Raising Flour.—I should feel obliged if any one could give me information as to what material is introduced into flour to constitute it "self-raising." I have made a few rough analyses, but they have resulted in nothing. No carbonic anhydride is given off on treating the flour with water or with an acid.—B.Sc.

Lead Chromate.—(Reply to "Colourman.")—The following plan will best answer your purpose:—Take a solution of 33 parts of acetate of lead in 100 parts of water; precipitate this first by a solution of 22 parts of carbonate of soda in 60 parts of water, let the precipitate settle, and then decant the water. Next, add to the precipitate a solution of 17½ parts of neutral chromate of potassa in 50 parts of water; take care to stir this mixture well, and, after collecting on a filter, wash, press, and dry. The chromate thus prepared remains bright yellow, and does not redden by being ground up with water. The process is described at length in Dingler's *Polytechniches Journal*, vol. lxxxvi., p. 438.

Fairfax's Test-Papers.—In justice to chemical students, I think the following points respecting "Fairfax's test-papers" should be made known:—(1) When placed in distilled water, the colouring matter is dissolved out in a few minutes, and leaves the paper so as to be totally unaffected by either acids or alkalies. (2) Sulphuretted hydrogen *gas* immediately decolourises it, indicating, according to the inventor's directions on the cover, a substance of an alkaline nature. The colour cannot be restored by acetic acid, but by one of the stronger acids, such as sulphuric. (3) The paper is apparently kept moist by chloride of calcium, the result being that the colouring matter stains anything with which the paper is placed in contact. These points scarcely bear out the announcement upon the cover—viz., that it is "the most delicate test for ordinary acids and alkalies," and "litmus superseded."—T. B.

MEETINGS FOR THE WEEK.

Monday, 30th.—London Institution, 4.
Tuesday, 31st.—Institution of Civil Engineers, 8.
—— Royal Institution, 3. Prof. Seeley, "On Present English History."
Thursday, June 2nd.—Royal Institution, 3. Prof. Tyndall, "On Electricity."
—— London Institution, 7.30.
—— Royal Society Club, 6.
—— Royal, 8.30.
—— Chemical, 8. Dr. Odling, "On the Platinum Ammonias."
Friday, 3rd.—Royal Institution, 8. Prof. Max Müller, "Migration of Fables."
—— Geologists' Association, 8.
Saturday, 4th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."

THE CHEMICAL NEWS.

VOL. XXI. No. 549.

ON THE

PRESENCE OF POTASH IN CHROMATE OF LEAD.

By Dr. T. L. PHIPSON, F.C.S.,
Member of the Chemical Society of Paris.

ON making the analysis of some organic compounds recently introduced into the arts, it struck me that the carbon determinations obtained by oxide of copper were rather higher than those obtained by chromate of lead. The difference was slight, but nearly sufficient, in one case, to modify the formula deduced from the results.

It then occurred to me that this might be due to a small quantity of potash retained by the fused chromate of lead. I therefore acted upon some 500 grms. of this compound with boiling distilled water, and detected potash in the filtrate in every instance. The samples examined were prepared, I believe, in Germany. Four of them were tested quantitatively, and gave from 0·01 to 0·02 per cent of potash. Although so small, this amount of potash might, in some cases, influence the results of combustion, unless certain precautions are taken, as will be easily seen by taking into consideration the great weight of chromate of lead which enters the combustion-tube, and the small weight of matter usually subjected to combustion in order to ensure complete results.

Taking the most favourable view of the case, the quantity of matter burnt being stated at 0·100 grm., and the quantity of potash existing in the chromate of lead at 0·01 per cent, the quantity of chromate of lead which is used in the ordinary-sized combustion-tubes may be set down at 140 to 150 grms. Let us say only 100 grms. (for this quantity may be reduced to even less). In this case, we should have a certain loss of 1·2 per cent of carbon in the analysis.

The precautions to be taken to avoid error from this source are:—To use a slight excess of lead-salt in the preparation of the chromate, and to wash thoroughly with boiling water; to test occasionally for potash the chromate of lead supplied by commerce for the purpose of organic analysis; instead of 140 to 150 grms. of chromate in the combustion-tube, to take not more than 70 to 75, which may in most cases be easily done by using a narrower and rather shorter tube; and, finally, to take as large a quantity of the substance (0·2 to 0·5 grm.) as can be conveniently or safely taken for the analysis.

In these circumstances, chromate of lead will retain all its superiority over oxide of copper as an agent of combustion.

Analytical Laboratory, Putney, S.W.

EXPERIMENTS ON THE

EFFECT OF ALCOHOL (ETHYLIC ALCOHOL) ON THE HUMAN BODY.*

By E. A. PARKES, M.D., &c.,
and
COUNT C. WOLLOWICZ, M.D., &c.

THE authors, eminent army medical and scientific men, took the opportunity which the willingness and zeal of a very intelligent healthy soldier afforded them, of investigating the subject above alluded to, which, very rightly, they consider of great importance for the precise knowledge of the physiological effects of alcohol on the human system. As might be expected, this paper describes, exhaustively and at great length, all the experiments made, and the conditions under which they were made. We can only give here a brief *résumé* of the general conclusions arrived at, from which we learn that small quantities of absolute alcohol (1 and 2 fluid ounces = respectively to 28·4 and 56·8 c.c.), given in divided doses to a perfectly healthy man, seemed to increase his appetite; 4 fluid ounces lessened it considerably, and larger quantities almost destroyed it. In other healthy persons, it may be different from the above; while, in most cases of disease, it seems probable that a much smaller amount of alcohol would destroy appetite. The number of beats of the heart in twenty-four hours (as calculated from eight observations made in fourteen hours) increases very largely—viz., an average of more than 13 per cent; while the actual work done by the heart in excess was found to be equal to lifting 15·8 tons 1 foot, and during the two last days of the experiment it did extra work, to the amount of 24 tons lifted as far. These few particulars, all belonging to physiology, may suffice to give a slight idea of the great merits of this paper, from which highly valuable conclusions may be drawn in respect of the use of, and far more the abuse of, ardent spirits. Although these were unknown as beverages some 200 years ago, they are now consumed to such an extent, that, for every man, woman, and child in Scotland, there is consumed annually 10 litres of alcohol, at 59 per cent of absolute alcohol, by bulk, chiefly in the shape of whisky.

* Abstract of a paper read before the Royal Society, May, 1870.

ON A NEW APPARATUS FOR REDUCING CHLORIDE OF SILVER.*

By A. LEIBIUS, Ph.D.,
Assayer to the Sydney Branch of the Royal Mint.

IN the refinage of gold bullion by Miller's new chlorine process, the silver contained in the alloy thus treated is eliminated from the latter in the state of argentic chloride, which, by a subsequent process, is reduced to metallic silver.

This reduction has always been effected in the usual manner, viz., by placing the slabs of fused argentic chloride between plates of wrought-iron or zinc, with the addition of acidulated water. Although a perfect reduction to metallic silver has always been achieved, yet it required a considerable amount of time and manipulation, since the thick slabs of fused argentic chloride were, after two to three days, only partially converted into metallic silver, and had to be re-arranged in order to expedite their complete reduction. Such manipulations, however, were not only found to be very objectionable on account of the time they required, but more so on account of the very disagreeable work which they caused to the operator. The reduced spongy silver was broken up, by hand, into small pieces, in order to ascertain its complete reduction, and was then boiled in acidulated water to free it from iron or zinc.

It remained, therefore, a desideratum to effect the reduction of the fused masses of argentic chloride in a manner which would, at the same time, be quicker in its execution, and also obviate the just-alluded-to manipulations.

In 1868, Messrs. De la Rue and Hugo Müller, in London, constructed a galvanic battery, one pole of which consisted of fused argentic chloride the thickness of a goose-quill, the other pole of cylinders of zinc. Adopting this principle, I have endeavoured to construct an apparatus which should fulfil the requirements before referred to.

* Read before the Royal Society of Victoria.

After operating successfully with a small model which allows the reduction of about 250 ozs. of argentic chloride in one operation), I have, with slight modifications, constructed an apparatus which will reduce from 1400 to 1500 ozs. of argentic chloride in 24 hours. The apparatus and its dimensions are as follows:—

Two thick boards, 15 inches long, are joined together on both ends by three strong battens, so as to form an open box without a bottom, 13 inches long by 14 inches wide, and 15 inches high (inside measurement). The two boards forming the length of the box or frame contain seven vertical grooves, ¼ inch wide and ¼ inch deep, at intervals of 1½ inches from each other. These grooves are cut down to a length of 12 inches, leaving 3 inches of each board forming the legs of the frame.

At the termination of these grooves passes horizontally a narrow slit, ¼ inch deep, and along the whole length of each board, into which a strip of metallic silver, ¼ inch wide and the thickness of about a threepenny-piece, is tightly fixed, projecting on one side of the frame about 18 inches beyond each board.

The seven grooves already alluded to are for holding zinc plates, ¼ inch thick, 14 inches long, and 12 inches high, which rest on both sides on the strips of silver, which, as just described, are jammed horizontally into the sides of the two boards. A connection is thus established between the seven zinc plates and these strips of silver.

The second part of the apparatus consists of a wooden frame, cut out of a solid board 1 inch thick, and supplied with two large iron handles. This frame is the same length as the box holding the zinc plates, but 3 inches narrower. It contains on each side, parallel to the direction of the zinc plates, twelve slits ¼ inch long, which hold silver bands ¼ inch broad and the thickness of a threepenny-piece. These silver bands are passed through the slits in the board, so as to form on each side of it six loops, 11½ inches in length and ¾ inch wide. The six loops on one side are exactly opposite to those on the other side of the board, at a distance of about 9 inches. They are intended to hold the slabs of argentic chloride, which are 12 inches long, 10 inches high, and about ¾ inch thick, and are put through these loops lengthwise, projecting on each end about 1 inch beyond the silver bands.

The whole frame holds, as before stated, six of these slabs of argentic chloride, which are placed between the six spaces formed by the seven zinc plates, from which latter they are about ¾ inch apart on each side.

The projecting horizontal strips of silver jammed into the sides of the lower frame are then connected with the ends of the silver forming the loops in which the argentic chloride is suspended; and the whole apparatus thus charged is placed in a tub filled with water. After a short time, galvanic action is discernible; the liquid gets gradually warmer, and a strong galvanic current is observed. After about 24 hours, the action has nearly ceased, and the whole argentic chloride is found to be completely reduced to metallic silver, which retains in the silver loops the same shape, and, outwardly, also nearly the same appearance as when first introduced as argentic chloride. The latter contains always more or less chloride of copper (eliminated together with the silver during the operation of refinage by chlorine), which is reduced together with the chloride of silver; in fact, this soluble chloride of copper helps to act as an exciting liquor for the battery. In the first experiments, a weak solution of salt (chloride of sodium) was used as exciting liquor; but it was found that this could be dispensed with, and only common water used (the action, however, is, in this case, a little retarded and does not become powerful until about two hours after the battery is set). By using a part of the resulting liquor from a previous reduction of argentic chloride, and which contains chloride of zinc, it has been found that the galvanic action sets in very rapidly, and accelerates thereby the completion of the reduction.

No acid is used; and, therefore, the amount of zinc used in each reduction has invariably been found to be almost the theoretical quantity required to combine the chlorine of the argentic chloride treated with the metallic zinc, in order to form chloride of zinc.

The quantity of metallic zinc thus used was always from 24 to 25 per cent of the weight of the argentic chloride reduced.

The reduced silver is boiled out in acidulated water, in order to remove the basic and oxy-chlorides, and finally in pure water, while still suspended in the silver loops. As soon as it is taken off the last boiling, it is immediately ready for the melting-pot, since the heat from the boiling water dries the porous mass of silver sufficiently to allow of its immediate melting. The seven zinc plates, when first used, weigh about 140 lbs. avoirdupois; the six slabs of argentic chloride, of the dimensions already given, weigh about 1400 ozs. troy.

The zinc plates are used over again, until too thin for that purpose, when they are re-melted, and cast into new plates. It has been found that the quantity of zinc used is little, if at all, increased by prolonging the time of connection with the silver plates after the reduction is completed; the whole apparatus, when once set in operation, can therefore be left to itself until it is found convenient to melt the reduced silver.

While this apparatus reduces the argentic chloride much quicker than if the latter is simply placed in contact with zinc or iron plates, it obviates any handling of the argentic chloride from the time the latter has been placed in the silver loops until the reduced silver is ready for the melting-pot;—advantages which have been fully appreciated by those who formerly had to resort to tedious and disagreeable manipulations.

ON THE SULPHO-ACIDS OF BENZOL.

By A. ROSS GARRICK,
Balyett, Stranraer, Scotland.

(Concluded from p. 245.)

Salts of Isosulphobrom-Benzolic Acid.

Isosulphobrom-benzolate of Lead—

$$(C_6H_4BrSO_3)_2Pb + 3H_2O.$$

The lead-salt crystallises in small corny crystals. It contains three molecules crystal water, and is more readily soluble in water than the lead-salt of the former acid. It is prepared by neutralising a solution of the acid with lead carbonate.

Water estimation—0·4922 grm. of the salt dried in the air lost, at 110°, 0·0340 grm. = 6·90 per cent H_2O.

Lead estimation—0·4708 grm. of the dry salt gave 0·2120 grm. lead sulphate = 30·76 per cent Pb.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2Pb$ ..	679	92·64	—
$3H_2O$	54	7·36	6·90
	733	100·00	
$(C_6H_4BrSO_3)_2$ ..	472	69·52	—
Pb	207	30·48	30·76
	679	100·00	

Isosulphobrom-benzolate of Zinc—

$$(C_6H_4BrSO_3)_2Zn + 6H_2O.$$

The zinc-salt, as prepared from the lead-salt by precipitating the lead exactly with a solution of zinc sulphate, forms very indistinct crystals easily soluble in water. It forms a marked contrast to the beautiful crystalline zinc-salt of the former acid.

Water estimation—(1) 0·1337 grm. of the salt dried in the air lost, at 110°, 0·0266 grm. = 16·82 per cent H_2O. (2) 0·2395 grm. of the salt dried in the air lost, at 110°, 0·0397 grm. = 16·57 per cent H_2O.

Zinc estimation—0·1980 grm. of the dry salt gave, on ignition, 0·0306 grm. = 12·27 per cent Zn.

	Calculated.		Found.	
			I.	II.
$(C_6H_4BrSO_3)_2Zn$ ..	537·2	83·27	—	—
$6H_2O$	108·0	16·73	16·82	16·57
	645·2	100·00		
$(C_6H_4BrSO_3)_2$	472·0	87·89	—	
Zn	65·2	12·11	12·27	
	537·2	100·00		

Isosulphobrom-benzolate of Barium—

$(C_6H_4BrSO_3)_2Ba + 2H_2O$.

The barium-salt differs entirely from the barium-salt of the former acid. It crystallises in radiated fibres containing two molecules crystal water. The barium-salt of former acid forms splendid leaflets of a silver glance.

By neutralising a solution of the acid with barium carbonate, filtering, and evaporating, this salt is obtained.

Water estimation—0·3791 grm. of the salt dried in the air lost, at 110°, 0·0203 grm. = 5·32 per cent H_2O.

Barium estimation—0·3555 grm. of the dry salt gave, on ignition, 0·1358 grm. barium sulphate = 22·45 per cent Ba.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2Ba$ ..	609	94·39	—
$2H_2O$	36	5·61	5·32
	645	100·00	
$(C_6H_4BrSO_3)_2$ ..	472	77·51	—
Ba	137	22·49	22·45
	609	100·00	

Isosulphobrom-benzolate of Calcium—

$(C_6H_4BrSO_3)_2Ca + H_2O$.

The calcium-salt forms small colourless crystals closely grouped together, which are easily soluble in water. It remains unchanged on exposure to the air, whereas the calcium-salt of the former acid is efflorescent and crystallises in large monoclinic prisms. It is prepared by neutralising a solution of the acid with calcium carbonate.

Water estimation—0·02365 grm. of the salt dried in the air lost, at 110°, 0·0088 grm. = 3·72 per cent H_2O.

Calcium estimation—0·2300 grm. of the dry salt gave 0·0602 grm. calcium sulphate = 7·65 per cent Ca.

	Calculated.		Found.
$(C_6H_4BrSO_3)_2Ca$ ..	512	96·60	—
H_2O	18	3·40	3·72
	530	100·00	
$(C_6H_4BrSO_3)_2$	472	92·58	—
Ca	40	7·42	7·65
	512	100·00	

Isosulphobrom-benzolate of Potassium—

$C_6H_4BrSO_2KO + H_2O$.

The potassium-salt is exceedingly soluble in water. It crystallises in star-shaped groups containing water of crystallisation. The potassium-salt of the former acid forms large distinct rhombic plates, and is less soluble in water than this salt.

It is prepared from a solution of the barium-salt by precipitating the barium exactly with potassium sulphate.

Water estimation—0·2298 grm. of the salt dried in the air lost, at 110°, 0·0085 grm. = 3·69 per cent H_2O.

Potassium estimation—0·2620 grm. of the dry salt gave 0·0868 grm. potassium sulphate = 14·53 per cent K.

	Calculated.		Found.
$C_6H_4BrSO_2KO$ ..	275·11	96·83	—
$\frac{1}{2}H_2O$	9·00	3·17	3·69
	284·11	100·00	
$C_6H_4BrSO_3$	236·00	85·79	—
K	39·11	14·21	14·53
	275·11	100·00	

If we examine the characteristics of the two acids which, with their salts, have just been described, we cannot doubt but that we have to do with two entirely distinct bodies. Each salt of one acid differs very strikingly from the corresponding one of the other acid—no two analogous salts possess the least degree of resemblance with each other. In addition to this, the sulphobrom-benzolic acid first prepared is much less deliquescent than the following isomeric acid; the fusing-point could be with ease determined, and was found exactly at 88°. The isosulphobrom-benzolic acid, on the other hand, becomes liquid almost instantaneously on coming in contact with the air, so that all attempts at determining the fusing-point were entirely fruitless.

The physical properties compel us, then, to consider the two acids as isomeric, and not identical. Other means for characterising the two we do not possess, but circumstances cannot possibly work such differences in one and the same body as we observe between these two acids and the salts derived from them.

In the preparation of isosulphobrom-benzolic acid, after acting on sulphobenzolic acid with bromine in a sealed tube, the residue was dissolved in water and evaporated on the water-bath until freed from hydrobromic acid. On attempting to dissolve the residue, a substance separated, leaving the acid in solution. This was then separated by filtration, dissolved in alcohol, and, by allowing the solution to stand, needle-shaped crystals were obtained. It seemed probable that the crystals were those of tetrabrombenzol; and, on making an estimation of the amount of bromine, results were obtained agreeing pretty closely with the theoretical percentage of bromine contained in that compound. The small amount of substance at command rendered it impossible to make an estimation of the other constituents, or to control the estimation of bromine made.

Bromine estimation—0·1063 grm. of the substance gave 0·2007 grm. silver bromide = 80·33 per cent Br.

	Calculated for tetrabrombenzol, $C_6H_2Br_4$.		Found.
Carbon	72	18·28	—
Hydrogen	2	0·51	—
Bromine	320	81·21	80·33
	394	100·00	

On the Preparation of the Isomeric Diatomic Phenols from the Sulpho-Acids of Benzol.

The principal object of scientific chemistry at the present day is not the simple discovery of new chemical individuals. Although they are constantly appearing in all researches in the field of science, still they merely aid the investigator in simplifying, in systematising known facts. He accepts certain theories as a foundation for his researches; and, while he acknowledges the possibility that these accepted theories may be false, he nevertheless works on the assumption that they are true. If new facts brought forward by him present no points which speak against the theories, he has no right to disbelieve them-

all events, not the right of experience. He must, on the contrary, if possible, show in what relation his researches stand to the ruling theories. If he then succeeds in proving the true position of but one substance, he has accomplished something towards the one grand end of the science—classification.

All the derivatives of benzol in which two hydrogen atoms are replaced by other univalent groups have been divided into three series, called, respectively, the ortho, para, and meta series. Of each derivative, there exists three isomeric varieties, corresponding to the three series. The difference between the three varieties arises from a difference in the arrangement in the substituting radicals in the molecule.

In consequence of characteristic reactions and methods of formation, the three isomeric diatomic phenols or hydroxyle derivatives of benzol have been placed as follows:—

Ortho series.	Para series.	Meta series.
Hydroquinone.	Resorcin.	Pyrocatechin.

We are, however, in possesion of an elegant method for the formation of these phenols from the sulpho-acids. This is the method described by Kekulé, Würtz, and Dusart. It consists in fusing, at a high temperature, the potassium-salts of the sulpho-acids with potassium hydrate. By this means, the potassium hydrate acts upon the group SO_2HO, forming potassium sulphite and hydroxyle, which latter remains in the benzol molecule. The same thing takes place if one hydrogen is replaced by bromine or chlorine, with the difference, of course, that bromide or chloride of potassium are formed.

By applying this method to the acids above described, I have been enabled to show to which of the three groups they each belong.

Preparation of Resorcin, $C_6H_4\{^{HO}_{HO}$, *from Disulphobenzolic Acid.*

It was highly probable that, by adopting the method of Kekulé, Würtz, and Dusart, one of the three isomeric phenols (hydroquinone, resorcin, pyrocatechin) could be prepared from disulphobenzolic acid.

For this purpose, the potassium-salt of this acid was fused with three times its weight of potassium hydrate at a temperature of about 230° for two hours. The reaction proceeds as follows:—

$$C_6H_4(SO_2KO)_2 + 2KHO = C_6H_6O_2 + 2SO_3K_2.$$

The fused mass was then dissolved in water, acidified with dilute sulphuric acid, shaken up two or three times with ether, and the etherial solution distilled on the water-bath. On concentrating the residue by evaporation, the solution separated out into distinct crystals. The crystals, which were of a dark colour, were allowed to stand over sulphuric acid, and then subjected to distillation, and the distillate collected between 270° and 280°.

The substance was subjected to analysis after standing for some time over sulphuric acid.

0·2662 grm. of the substance on combustion with cupric oxide, gave 0·6377 grm. carbonic acid = 65·32 per cent C.

0·2662 grm. gave 0·1365 grm. water = 5·69 per cent H.

	Calculated for $C_6H_6O_2$.	Found.
Carbon	65·45	65·32
Hydrogen	5·45	5·69
Oxygen	29·10	—
	100·00	

These results correspond to the formula $C_6H_6O_2$.

The substance, even in the pure condition, retained the smell of the phenols, and was soluble in water, alcohol, and ether. It melted exactly at 104°, which corresponds to the melting-point of resorcin given by Oppenheim and Vogt (*Ann. Chem. Pharm.*, Suppl., vol. vi., 376).

Its boiling-point agrees with that of resorcin, whereas at the temperature at which it was distilled hydroquinone is not decomposed and pyrocatechin boils at 245°.

The fact that its solution became of a dark violet colour on the addition of a solution of ferric chloride, proved farther, without doubt, that the body so prepared was resorcin.

Adopting the method of Kekulé, Würtz, and Dusart, Oppenheim and Vogt (*Ann. Chem. Pharm.*, Suppl., vol. vi., p. 376) succeeded in preparing resorcin from sulphochlorbenzolic acid. For this purpose, they first prepared monochlorbenzol by the method recommended by Müller—viz., dissolving iodine in benzol, and for several hours conducting chlorine into the solution. The product was then subjected to fractional distillation, and the distillate collected from 130° to 140°. They then heated the monochlorbenzol so prepared with a little more than an equivalent of sulphuric acid. The crude acid was then dissolved in water, and freed from excess of sulphuric acid by treating it with barium carbonate. The barium was then precipitated with potassium carbonate, and the solution evaporated. The sulphochlor-benzolate of potassium so obtained was then fused with potassium hydrate in different proportions. In an experiment tried by fusing this salt with only a small proportion of potassium hydrate, dissolving the fused mass in water, neutralising with hydrochloric acid, and then shaking up with ether, they obtained a product containing chlorine.

By, however, employing a larger proportion of potassium hydrate, the red colour which was produced in the previous experiment was entirely destroyed; and, on neutralising the fused mass with hydrochloric acid, after dissolving the mass in water, and shaking up with ether, a solution was obtained free from chlorine. From this solution, they obtained, by spontaneous evaporation, crystals of a columnar or plate form, which were purified by subjecting them to distillation.

By analysis, they proved the substance to correspond to the formula of—

$$C_6H_6O_2 = C_6H_4\{^{HO}_{HO}.$$

The crystals they describe as retaining the odour of phenol, having a sweet taste, and being soluble in water, alcohol, and ether.

The melting-point they found to be 104°, being 3° higher than the melting-point of resorcin as given by Hlasiwetz and Barth (*Ann. Chem. Pharm.*, vol. cxli., p. 224).

Preparation of Resorcin, $C_6H_6O_2 = C_6H_4\{^{HO}_{HO}$, *from Sulphobrombenzolic Acid.*

The fact that the sulphobrom-benzolic acid was prepared in a manner analogous to that adopted in the preparation of the sulphochlor-benzolic acid, made it appear highly probable that it would also yield resorcin by applying the same method for introducing the hydroxyle groups.

Sulphobrom-benzolate of potassium was accordingly fused with three times its weight of potassium hydrate at a temperature of about 275° for two hours. The reaction proceeds as follows:—

$$C_6H_4\{^{Br}_{SO_2KO}\} + 2KHO =$$

$$= C_6H_4\{^{HO}_{HO}\} + KBr + KSO_2KO.$$

The fused mass was then dissolved in water, acidified with dilute sulphuric acid, and shaken up with ether. The etherial solution was distilled on the water-bath, the residue concentrated by evaporation, and distilled. The substance so produced was exceedingly soluble in water, alcohol, and ether. On exposure to the air, it became rapidly of a reddish colour. The fact, also, that it became of a dark violet colour on the addition of a solution of ferric chloride furnished sufficient proof of the identity of the substance prepared with resorcin.

Preparation of Hydroquinone, $C_6H_6O_2 = C_6H_4 \begin{cases} HO \\ HO, \end{cases}$

from Isosulphobrom-benzolic Acid.

That in the same way one of the two remaining isomeric phenols (hydroquinone, pyrocatechin), could be prepared from isosulphobrom-benzolic acid, was in the highest degree probable.

Adopting the same method, isosulphobrom-benzolate of potassium was fused with three times its weight of potassium hydrate, at a temperature of about 275°, for two hours; the residue dissolved in water, acidified with dilute sulphuric acid and shaken up with ether. The etherial solution was then distilled on the water-bath.

It now remained to be determined which of the two isomeric compounds was produced. Advantage was taken of the property of pyrocatechin to form, on the addition of lead acetate, a compound insoluble in water, whereas the hydroquinone remains in solution. By obtaining no precipitate on the addition of lead acetate, satisfactory proof was given of the absence of pyrocatechin. The solution was then decomposed with hydrosulphuric acid, filtered, and concentrated by evaporation on the water-bath.

On the addition of ferric chloride to a solution of the substance, a green precipitate was produced = quinhydrone, or green hydroquinone, $C_{12}H_{10}O_4$. On boiling this solution, this substance was decomposed, the characteristic odour of quinone was produced, and a brown material remained behind.

These reactions render it highly probable that by this process hydroquinone is produced. Certain it is that no pyrocatechin is produced, as this must have been precipitated by the addition of lead acetate to a solution containing it, whereas, as we have seen, no precipitate separated. Not a single reaction could give rise to a suspicion that the substance was resorcin. Unfortunately, the small quantity of substance at command did not suffice to answer the qustion, beyond a doubt, whether the substance duced was hydroquinone or not. As, however, the negative proof—viz., that it was neither pyrocatechin nor resorcin—is well established, we are justified in concluding that hydroquinone was produced.

As a result of these experiments, we can then draw the following conclusions:—

1st. In disulphobenzolic acid, sulphochlor-benzolic acid, and sulphobrom-benzolic acid, the substituting radicals have the same relative position to each other; and this is the same as that which exists betwen the hydroxyle groups in resorcin. This shows them to belong to the para series.

2nd. Isosulphobrom-benzolic acid belongs to the ortho series, the SO_2HO and Br standing to each other in the same relation that HO and HO stand to each other in hydroquinone.

Ortho series.	Para series.	Meta series.
Isosulphobrom-benzolic acid.	Sulphochlor-benzolic acid.	—
—	Sulphobrom-benzolic acid.	—
—	Disulphobenzolic acid.	—

A

LABORATORY OF EXPERIMENTAL RESEARCH.*

By Prof. ALBERT R. LEEDS.

ONE of the most important services rendered by the great Swedish chemist to his beloved science was that he freed it from its previously-attendant mystery and discomfort—its dirt and gloom. The cold outbuildings and damp stone floors, hitherto thought proper for destructive acids and noxious vapours and dangerous furnace-fires, were too unwholesome to be endured through the protracted severities of a Swedish winter; and so Berzelius carried his crucibles into comfortable rooms in his own dwelling, made the clumsy furnace yield to his convenient lamp, and made chemistry a science most cheerful and domestic. Among the young chemists who were attracted, by the spendour of his discoveries, to the home of Berzelius was Henry Rose. When, later in life, Rose became Professor of Chemistry in the University of Berlin, he also devoted two or three small rooms in his own house, and admitted to them a few students, who came, highly recommended for their skill and chemical knowledge, to work out analytical methods under his direction. Among them, and for several years his assistant, was Dr. Finkener, recently appointed Professor at the Berg Schule in Berlin. This Berg Schule occupies the Old Bourse, and the chemical laboratory is the large hall in which the bankers of Berlin were wont to assemble before their present magnificent Bourse upon the opposite side of the Spree was erected. The assiduity, care, and ingenuity which Dr. Finkener has displayed in the last, the sixth, and in former editions of Rose's great work on Analytical Chemistry, has given him a familiarity with analytical processes which has rendered him deservedly successful and popular as a teacher. To an American, the fees in the Institution appear incredibly small. For the daily use of the laboratory for five months, including gas, chemicals, and apparatus, the charge is 20 thalers (about 20 dollars in currency at the present time). Nor is this economy obtained at the sacrifice of those facilities which the student may reasonably expect in the present advanced state of chemical science. One or two agate mortars, a couple of steel mortars, the cork-borers, files, and other simple tools, the sand and water baths, &c., are the property and for the use of all. The students enforce the police regulations, and keep the laboratory in order. The apparatus for the evolution of sulphuretted hydrogen, carbonic acid, and hydrogen is arranged by an assistant; and the time of the student is not consumed in preparing these contrivances for himself: the same remark applies to the apparatus for the manufacture of chlorine, hydrofluoric acid, the determination of carbonic acid, nitrogen, &c.; to the burettes and standard solutions for volumetric analysis. In desk-room the student is limited, though not hampered for want of space. Of hood-room there is more than sufficient for all the evaporations and operations detrimental to health which the students are likely at any one time to be carrying on. How different from one of the largest of our American laboratories, where the regular charges are 100 dollars per term, and the incidental amount to a very considerable sum. Each student is required to consume time and money in constructing a sulphuretted hydrogen, carbonic, hydrogen, and other apparatus for himself; and, without he consumes more of both than most can afford, his apparatus, when completed, is inadequate to accomplish nice work or obtain accurate results. In respect to size and completeness, the laboratory of the Berg Schule at Berlin is much superior to that of the Mining School at Freiburg, now, and for many years past, under the direction of Professor Scheerer: the rooms are small, dark, and ill-provided with gas and apparatus.

Since the calamities which have fallen upon the kingdom of Saxony, the places of such as Breithaupt and his illustrious co-labourers have not been filled by men of equal renown; and the ancient glory of the Institution is departing. The student still goes to see the great cabinet of minerals accumulated by the father of Geology and his successor, and still may obtain excellent practical instruction in the determination of minerals. Here, as at some other places in Europe, and in our own country, where mineralogy is successfully taught, fragments of crystals are put into the hands of students, and they are expected, under the eye of the teacher, to determine their hardness, cleavage, and crystalline form. Their attention is directed to the peculiarities of surface condition, optical properties, &c.; and they are taught to substitute critical examination

* Communicated by Prof. Morton.

for slovenly guess-work. The fiery enthusiasm with which the old Professor of Metallurgy performs his duties still attracts students, who have finished their studies at other schools, to Freiburg for this special course; and nothing certainly can be more gratifying than the zeal with which the lynx eyes of the Professor follow the assay from the incipient stages of its preparation, through the blazing furnace, to the triumphant moment when the button emerges into view. The metallurgical apartment at the Ecole des Mines in Paris is more imposing in appearance: with its practical working I am not so well acquainted. The Free Laboratory in the Jardin des Plantes is adapted only to elementary work; that at the Ecole Centrale is dirty and dismal; and that of the Sorbonne, which was erected at about the same time as the great Frederick Wilhelm Laboratories at Bonn and Berlin, is not comparable to either in size, elegance, and completeness. In the latter of these two noble edifices, the beautiful lecture-room is provided with a special laboratory for the preparation of lecture experiments, and also a museum of such minerals, apparatus, models, and metallurgical and industrial products as are useful in demonstration or illustration. Between the spacious apartments for qualitative and quantitative analysis, there is a room devoted to the preparation of reagents. There are also separate apartments set aside for metallurgic and pharmaceutical processes, weighing-rooms, a library, a room for organic analysis, and one for students engaged in original investigation.

There is no provision, however, for the prosecution of researches in physics, and but scanty accommodations to workers in physiology. Prof. Magnus, of the University of Berlin, has devoted a few rooms in his dwelling to physical research; and, while I was engaged there, three other students were present, one occupied by an investigation in acoustics, another in polarised light, and a third in the measurement of crystals of recently-discovered chemical compounds. A laboratory of physics is greatly needed at the present time in our own country. The teachers of natural philosophy in our colleges have little opportunity for fitting themselves by a course of special training for their duties, and are seldom able to make or improve their apparatus, or to enter with success into experimental research. A chemist is able to effect little who has not acquired, by years of practice, skill in the conduct of analyses. So, too, other things being equal, he will be the most successful physicist who is the best mechanician. In such an institution, the mechanical ought to advance with the mathematical education; and, while the pupil is studying mensuration, he might be mastering the turning-lathe; and, while applying calculus to optics, in grinding and mounting a lens. We do not advocate such an education only for those who design to be physicists by profession, but regard it as best adapted to develop many minds, and to bring forth a kind of talent eminently useful. Where shall the civil engineer, the miner, or the architect get such an education at present? Yet, to all these men, the ability to construct, as well as to plan a house, machine, or engine would be of inestimable value. Moreover, a long course of theoretical instruction alone is dry, and oftentimes disheartening, especially to those who, with great native ingenuity and mechanical skill, have little facility in mathematics. Such a physical laboratory should have a carpenter's shop, with tools for all kinds of joinery and turning; a machine-room, with furnace, bellows, anvils, vices, lathes, &c., and a room for finishing apparatus and the nicer kinds of work. Under the conduct of skilled mechanics, the students might be taught to make the apparatus requisite to demonstrate the principles of natural philosophy; and, when they were prepared to undertake researches of their own, or to take their degrees as engineers, they would be able to cope with the practical matters which would occupy their time and energies. Besides the workshops, there should be separate rooms in a laboratory of this description, devoted to researches in heat and optics, including spectrum analysis, photometry, microscopy, and crystallography; to acoustics, electricity, and magnetism, and to the problems of engineering. We believe that there are many young men to whom an education of this kind would prove more attractive than any now obtainable, and that the practicable benefits, as well as the scientific results of such an institution would be very great.—*Journal of the Franklin Institute.*

ON THE

CHEMICAL ACTIVITY OF NITRATES.*

By EDMUND J. MILLS, D.Sc.

IN the course of his researches upon nitro-compounds, the author found it extremely desirable to submit the genetic relations of those bodies to a detailed examination; in other words, to trace the modifications undergone by nitryl as it is transmitted (from the chloride, hydrate, or free radical) through an adequate succession of combinations. One of the first steps in this direction is the preparation of nitrylic chloride, which can be most easily effected, according to a statement in Watts's "Dictionary of Chemistry,"† by the action of phosphoric oxychloride on plumbic nitrate—

$$3Pb(NO_3)_2 + 2PO Cl_3 = Pb_3(PO_4)_2 + 6NO_2 Cl.$$

Among other modes of verifying this equation, the examination of the residue left behind when excess of the oxychloride is heated with plumbic nitrate, and then distilled off in a current of dry air, appeared the most simple and obvious. The results were found not to agree with the equation; and after three nitrates had been tried, a law of chemical activity became evident, rendering the reaction worthy of pursuit for its own sake, although, as an available source of nitrylic chloride, it had failed entirely. The nature and mode of establishment of this law constitute the subjects of the author's memoir.

When a nitrate is treated with phosphoric oxychloride, as has just been mentioned, the residue contains phosphoric oxide and a metallic chloride. Within the limits of experimental error, or subject to other satisfactory explanation, the ratio between these two products is constant for each nitrate; and from that ratio a quotient α can be found as follows:—

$$\alpha = \frac{\frac{\text{weight of chlorine}}{Cl}}{\frac{\text{weight of phosphoric oxide}}{P_2O_5}} =$$

$$= \frac{\text{weight of chlorine}}{\text{weight of phosphoric oxide}} \times 4{\cdot}06$$

This quotient, which is different for each nitrate, is termed the "coefficient of chemical activity" of nitrates, and the method of obtaining it is designated the "method of ratios." The data from which α is deduced, namely, certain weights of argentic chloride and magnesic pyrophosphate, are, if singly considered, new with each experiment; they depend on time, rate of heating, the state of division of the nitrate, and other conditions. But, assuming the results to have been brought about under a law of chemical action, the values of α must be independent of those circumstances, by which the primitive numerator and denominator could have been only *pari passu* affected; they are related only to the actual occurrence of the reaction. This property, in a chemical ratio, has not, it is believed, been previously observed.

After describing the means employed for obtaining a current of dry air, the apparatus required for the reaction,

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* Abstract of a paper read before the Royal Society, May 19, 1870.

† Vol. iv., p. 77.

and the individual experiments which were severally made, the following table of results is given, M being the symbolic value of a nitrate, and $Q = \frac{M}{a}$.

	a	M	Q
Thallous nitrate	8·76	265·30	30·29
Argentic nitrate	5·48	169·94	31·01
Plumbic nitrate	5·17	165·56	32·02
Rubidic nitrate	2·38	147·40	61·93
Cæsic nitrate	2·21	195·01	88·24
Potassic nitrate	1·99	101·14	50·82
Sodic nitrate	1·70	85·05	50·03
Lithic nitrate	1·61	69·00	42·86

The above list probably contains all the metallic nitrates that can be completely dried, excepting nitrates derived from amines and amides, which in the present state of our knowledge of the phosphamides, it was evidently advisable to exclude.

In the silver group, the mean value of Q is 31·11; and the following equation may be accepted therefor:—

$$a = \frac{M}{31{\cdot}11}$$

In the potassium group we have likewise

$$a = \frac{M}{50{\cdot}42}.$$

Hence, within each set of nitrates, chemical activity is in direct proportion to symbolic value. It is further sufficiently apparent that (excepting subidic nitrate) a and M increase and diminish in the same general order. Within the limits of error, the Q column is an incomplete arithmetical series, the most probable value of whose first term is 6·258, so that

$$Q = m\,6{\cdot}258,$$

m being integral. Reasons are then adduced for identifying the number 6·25 with Dulong and Petit's constant of specific heat. Moreover, since the product of specific heat and symbolic value is, generally, n 6·25, and m is greater than n, taking $m = xn$ and s = the specific heat of a nitrate, we have

$$Q = xn\,6{\cdot}25,$$

but $Ms = n\,6{\cdot}25$;

$$\therefore Q = xMs,$$

$$\text{and } a = \frac{M}{Q} = \frac{M}{xMs} = \frac{1}{xs}$$

the expression for chemical activity in terms of specific heat. Comparing the coefficients (a, a') for any two nitrates, the following relations are obtained:—

$$\frac{a}{a'} = \frac{m'}{m} \cdot \frac{M}{M'} = \frac{x's'}{xs};$$

and it is shown that these formulæ agree sufficiently well with experiment. Where $m = m'$ and $x = x'$, we have the simple expression—

$$\frac{a}{a'} = \frac{M}{M'} = \frac{s'}{s}$$

The values of Q are strictly *equivalent* to each other in point of activity. The author believes that a is commensurate with the elective function of chemical attraction, first discovered by Bergman. He terminates the memoir with a reference to some well-known instances of chemical action (such as that of argentic nitrate on a mixture of aqueous potassic chloride, bromide, and iodide), as serving to bestow a presumptive generality on his principal conclusions.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor TYNDALL, LL.D., F.R.S. (Lecture III.)

63. By the friction of a woollen cloth, amber is endowed with the power of attracting light bodies. This substance was called Electron by the Greeks; hence the name Electricity was applied to the power of attraction exhibited by amber. This attraction remained an isolated fact for more than 2000 years.

64. In the year 1600, Dr. Gilbert, of Colchester, physician to Queen Elizabeth, showed that the power of attraction was shared by many other substances. Dry glass, for example, when rubbed by silk, and dry sealing-wax when rubbed by flannel, exhibit this attractive power: when they do so, they are said to be *electrified*.

65. An electrified body attracts and is attracted by all kinds of unelectrified matter; but *repulsion* may also come into play. Thus, rubbed glass *repels* rubbed glass, and rubbed sealing-wax repels rubbed sealing-wax; while rubbed glass attracts rubbed sealing-wax, and rubbed sealing-wax attracts rubbed glass.

66. Hence the notion of *two kinds* of electricity, one proper to vitreous bodies, and therefore called vitreous electricity; the other proper to resinous bodies, and therefore called resinous electricity.

67. These terms are improper, because, by employing suitable rubbers, we can obtain the electricity of sealing-wax from glass, and the electricity of glass from sealing-wax. We now use the term *positive* electricity to denote that developed on glass by the friction of silk; and *negative* electricity to denote that developed on sealing-wax by the friction of flannel.

68. Bodies endowed with the same electricity repel each other; while bodies endowed with opposite electricities attract each other. This is the fundamental law of electric action.

69. The rubber and the body rubbed are always endowed with opposite electricities. They always attract each other. The work done in overcoming this attraction appears as heat in the electric spark.

70. To find the kind of electricity with which a body is endowed, we must ascertain, by trial, the electricity by which the body is *repelled*; this, we may be sure, is the electricity of the body. *Attraction* does not furnish a safe test, because unelectrified bodies are attracted.

71. Some substances possess, in a very high degree, the capacity of transmitting the electric power, or condition; others possess, in a high degree, the capacity of intercepting it. The former bodies are called *conductors*, the latter bodies *insulators*.

72. The insulators were formerly called *electrics*, because they could be electrified by friction *when held in the hand*; the conductors were called *non-electrics*, because they could not be so electrified. The division is improper; because, if a conductor be insulated, it can readily be electrified. To keep it electrified, an insulator must be introduced between it and the earth.

73. What is electricity? Why should it adhere so tenaciously to some substances, and flow so freely through or along others? The human mind has made many attempts to imagine the inner cause of electric action, and it still continues to make such attempts. Formerly, it was thought that magnetism and electricity, as well as light and heat, were all the work of "imponderable matter," associated with the ordinary matter." In the case of light and heat, this conception has undergone profound modification, and we seem to see clearly the mechanical cause of both. But no similar clearness has as yet been attained with regard to electricity, though a strong presumption exists that our notions of it are destined soon to undergo a modification equally profound.

74. Meanwhile, we may employ the provisional conception furnished by the *theory of electric fluids*: it will enable us to classify our facts.

75. According to this theory, electrical attractions and repulsions arise from two invisible fluids, each self-repulsive, but both mutually attractive. The fluids are supposed to be mixed together, to form a compound neutral fluid in unelectrified bodies.

76. The act of electrification by friction consists in the forcible separation of the two fluids, one of which is diffused over the rubber, and the other over the body rubbed; but they may also be separated in another way, now to be illustrated.

77. If an electrified body be brought near an insulated, unelectrified conductor, but not into contact with it, the electrified body will decompose the compound fluid of the conductor, attracting one of its constituents and repelling the other. When the electrified body is withdrawn, the separated fluids re-unite and neutralise each other.

78. This forcible separation of the two fluids of a neutral conductor by the mere proximity of an electrified body is called *electric induction*. Bodies in this state are also said to be electrified by *influence*. Neutral bodies are attracted because they are first excited by induction.

79. When an insulated conductor is acted on by an electrified body, its repelled electricity is free, but its attracted electricity is held captive by the inducing electrified body. Connecting the conductor for a moment with the earth, its free electricity escapes; and then, on the removal of the electrified inducing body, the captive electricity is liberated, and diffused over the surface of the conductor.

80. Thus, by the mere proximity of the electrified body, and without establishing contact between it and the neutral conductor, we can charge the latter *with the opposite electricity*.

81. Two sheets of tin-foil (conductors) being separated from each other by a sheet of glass (an insulator), if one sheet have electricity imparted to it, it will act through the glass, and decompose the neutral electricity of the opposite sheet, attracting the one constituent and repelling the other.

82. If the second sheet be connected with the earth, the repelled electricity will flow away, and we shall have two mutually-attractive layers of electricity separated from each other by the glass.

83. If the one sheet of tin-foil be united with the other by a conductor, the two opposite electricities will flow together: the tin-foil is then said to be discharged. This discharge usually assumes the form of a spark.

84. If the surface of a cake of resin, or of a sheet of vulcanised india-rubber, be electrified, a plate of metal laid upon it will have its neutral fluid decomposed, its positive fluid being attracted and its negative repelled. On touching the metal plate, its free (repelled) electricity flows to the earth; and now, if the plate be raised by an insulating-handle, it will appear charged with positive electricity. This is the principle of the *Electrophorus*.

85. An electric machine consists of two parts; the insulator, which is excited by friction, and the prime conductor.

86. The first electric machine consisted of a ball of sulphur, which was rubbed against the hand. It was invented by Otto Von Guericke, Burgomaster of Magdeburg, in the year 1671. A sphere of glass was afterwards introduced, then a cylinder of glass, and finally a round glass plate, which was rubbed with dry silk.

87. The prime conductor is thus charged:—When the glass plate is turned by a handle, it passes between the silk rubbers, and is positively electrified. The electrified glass then acts by induction upon the prime conductor, attracting the negative electricity and repelling its positive. The conductor is furnished with points, from which the negative electricity streams out against the excited glass. Thus the prime conductor is charged, not by directly communicating to it positive electricity, but by robbing it of its negative, the positive remaining behind.

88. The arrangement mentioned in Note 81 is virtually a Leyden-jar. Were the plate of glass there referred to moulded into the shape of a jar, one sheet of foil would cover its interior and the other its exterior. When the jar is connected with an electric machine, its charged interior coating acts by induction across the glass on the exterior coating, attracting the opposite and repelling the similar electricity.

89. In the experiment which led to the discovery of the Leyden-jar, *the hand of the experimentalist* served as the outer coating.

90. The escape of the repelled electricity of the outer coating to the earth leaves the captive electricity exposed solely to the attraction of that within the jar, and enables the jar to take a strong charge.

91. When the outer and the inner coatings are connected by a conductor, *an electric current* passes from the one to the other.

92. The current starts at the same instant from the inner and outer coatings, the *middle* point of the conductor being reached last by the current. This indicates that there are *two* currents, which start at the same moment from the inner and outer coatings.

93. It is agreed to call the direction in which the *positive* electricity flows *the direction of the current*.

94. When an electric current encounters resistance in its passage, heat is developed. This heat is sometimes so intense as to reduce metals to a state of vapour.

95. When a body is intensely electrified, it will discharge its electricity to an unelectrified body across an interval of air, in the form of an electric spark. Two bodies, oppositely electrified, discharge to each other in the same way.

96. When two oppositely-electrified clouds discharge towards each other, the track of the lightning marks the course of an electric current, and the sound of the thunder is the sound of an electric spark.

97. An electrified cloud, if it come near the earth, may discharge its electricity to the earth in the same way.

98. If the body through which the atmospheric electricity passes be a good conductor, and of sufficient size, no harm is done; but the *resistance* offered by trees, houses, and animals to the passage of the electricity usually causes their destruction.

99. The nervous system requires a certain interval of time to become conscious of pain. The time of an electric discharge is but a small fraction of this interval; hence, as a sentient apparatus, the nervous system is destroyed before consciousness can set in. If this be true (and there are the strongest grounds for believing it to be true), death from lightning must be painless.

100. When an electrified cloud passes over a pointed lightning-conductor, the opposite electricity of the earth is discharged from the point of the conductor against the cloud. The cloud is thus neutralised, and, in general, without producing thunder.

101. The duration of an electric spark amounts only to an extremely small fraction of a second. On this account, when moving bodies are suddenly illuminated by the spark from a Leyden-jar, they appear to *rest* for a short interval in the position which they occupied when the flash fell upon them. A moving cannon-ball, illuminated by a flash of lightning, appears to stand still for about one-eighth of a second, this being about the interval during which an impression, once made, persists upon the retina.

102. The unretarded electric spark will scatter gunpowder, but will not ignite it. To produce ignition, it is necessary to retard the discharge by sending it through a wet string.

103. If we double the quantity of electricity imparted to the same conductor, the density of the electricity is said to be doubled; if we treble the quantity, the density is said to be trebled, and so on.

104. On a *sphere*, the density of the electricity is the same at all points of its surface; on a *plate*, the density is greatest at the edges; and, on an elongated conductor, the density is greatest at the ends.

105. When the conductor ends in a sharp point, the electric density at the point is so great that the electricity discharges itself into the air.

106. The air thus electrified is self-repellent, and is also repelled by the point, the so-called "electric wind" being produced.

107. By causing an electric wind to issue from opposite points of a light body, the reaction of the two winds may make the body to float in stable equilibrium in the air.

108. The outer ends of two pieces of zinc and platinum, partially immersed in acidulated water, are in opposite electrical conditions. The free platinum-end shows positive electricity, while the free zinc-end shows negative electricity.

109. When both plates are united by a wire, the positive flows along the wire towards the negative, and the negative towards the positive; but, as mentioned in Note 93, it is agreed to call the direction in which the positive electricity flows *the direction of the current.*

110. The force which urges this current forward (the electromotive force) is enormously less than that which urges forward a current of frictional electricity. The consequence is that the latter is able to surmount resistances which are totally insurmountable by the former.

111. But, by linking cells together, we cause the voltaic current to approach more and more to the character of the frictional current. It requires, however, a battery of more than a thousand cells to make the current from a voltaic battery jump over an interval of air 1-1000th of an inch in length. An electric machine of moderate power, and furnished with a suitable conductor, is competent to urge its current across an interval ten thousand times as great as this.

112. The electric spark passes through air by the agency of the particles of the conductor from which it springs, and which are carried forward by the discharge.

113. But, measured by other standards, the frictional current is almost incomparably more feeble than the voltaic current: for example, it is not without special arrangements for multiplying the effect that the current from a large electrical machine is enabled to deflect a magnetic needle.

114. Faraday immersed two wires, the one of zinc and the other of platinum, each 1-13th of an inch in diameter, in a cell of acidulated water. The depth of immersion was only ½ inch, and the time of immersion only 3-20ths of a second; still, he found that the electricity generated by this small apparatus, in this brief time, produced a distinctly greater effect upon a magnetic needle than twenty-eight turns of the large electric machine of the Royal Institution.

115. A cubic inch of air, if compressed with sufficient power, may be able to rupture a very rigid envelope; while a cubic yard of air, if not so compressed, may exert but a feeble pressure upon the surfaces which bound it. Now, the electricity of the machine is in a condition analogous to the compressed air; its density, or, as it is sometimes called, its intensity or tension, is great. The electricity from the voltaic battery, on the other hand, resembles the uncompressed air; it exceeds enormously, in *quantity*, that from the machine, but it falls enormously below it in intensity.

116. The deflection of a magnetic needle, and other actions of the voltaic current, depend solely upon quantity; hence the vast superiority of the voltaic current in producing such deflection.

117. Faraday found the quantity of electricity disengaged by the decomposition of a single grain of water in a voltaic cell (see Note 5) to be equal to that liberated in 800,000 discharges of the great Leyden battery of the Royal Institution: this, if concentrated in a single discharge, would be equal to a great flash of lightning. He also estimated the quantity of electricity liberated by the chemical action of a single grain of water on 4 grains of zinc to be equal in quantity to that of a powerful thunderstorm.

118. Weber and Kohlrausch have found that the quantity of electricity associated with 1 milligramme of hydrogen in water, if diffused over a cloud 1000 metres above the earth, would exert, upon an equal quantity of the opposite electricity at the earth's surface, an attractive force of 2,268,000 kilogrammes.*

ROYAL IRISH ACADEMY.

At the last meeting of this Society, held at their House, Professor Jellett in the chair, Dr. R. M'Donnell, F.R.S., read a paper on "*A New Theory of Nervous Action as regards the Propagation of Sensation Along the Nerves.*"

The author's paper might be briefly described as an application of a theory similar to the wave theory of light to the propagation of sensation along the nerves. He compared this "undulatory" theory of nervous conduction with the hitherto more generally received hypothesis of distinct nerve-conductors, supposed to exist for each kind of sensation, pain, heat, tickling, &c.; and attempted to point out that the former is at once a simple hypothesis, and more in harmony with the ideas now prevalent as to the propagation of light, heat, electricity, &c.

The author also dwelt upon many points of analogy between the absorption or interception of waves of heat or of light and the somewhat similar phenomena as regards nerve-conduction where one kind of sensation is felt and another ceases to be any longer perceived, as in cases where the patient feels the contact of the hand, but cannot distinguish heat, or *vice versâ*.

CORRESPONDENCE.

ANALYSIS OF WATER.

To the Editor of the Chemical News.

Sir,—In your last number Mr. Spiller has commented on Professor How's analyses of an acid water from the coal-field at Stellarton. He thinks he has detected "one or two anomalies in the paper, which seem to have escaped the attention of the author, as well as of the gentlemen composing the 'committee of publication' of the *Chemical Society's Journal*;" and the first of these is an unusual arrangement of the constituents by which the chlorides of potassium and sodium are made to exist in solution in the presence of free sulphuric acid. Now, in reading the paper as it passed through the press I did observe this; but it never entered into my mind that it was my duty to correct the author's arrangement, especially as I thought he had as good a right to adopt that arrangement as any other of the same kind. No doubt it would have been more in accordance with received tradition to join the sulphuric acid to the potassium on the old principle of the strongest base to the strongest acid; but this rule is little else than an Idol of the Theatre, and there is this awkwardness about its application to the case in question that we do not know which is the stronger base potassium or sodium, or which the stronger acid, sulphuric or hydrochloric. In fact, there must have been both acids in a free state in the well and pond, for it has been established—at least, I consider it so—that where compounds of several bases and acids come together in solution, each acid arranges itself in combination with

* The metre is a yard and one-eighth in length; the milligramme is 1-2800th of an ounce; the kilogramme is 2 lbs. 3½ ozs.

each base in certain definite proportions dependent on the quantity of each of the constituents, and probably on the temperature: but what these proportions are in a colourless water no one can say; even the refractive index will scarcely help us.

It is true the results of these analyses might have been put down as so much calcium, magnesium, iron, potassium, sodium, and hydrogen, combined with so much chlorine, SO_4, and SiO_4, but neither the public nor chemists themselves are, perhaps, quite prepared for such a mode of representing the salts that exist in a water.

Should Mr. Spiller's letter, and this one, start a discussion as to the best method of recording the results of analysis in similar cases, they will do some good service.

How "a little alumina" got into the boilers is a question I shall leave for Professor How, if he chooses to explain it.

The third objection is of a totally different nature, and seems to arise from a misapprehension of Professor How's meaning. The statement that "the pond rests upon the measures immediately *underlying* the Acadia seam of coal" is intelligible enough if we remember what geologists mean by the term "underlying." If I am not misinformed these coal seams crop out at the surface, and that at a considerable angle; hence there is no difficulty in imagining a pond on the underlying coal measures in some place where the upper stratum has been removed either by the processes of nature or by the miner's art.—I am, &c.,

J. H. Gladstone.

May 30, 1870.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, May 23, 1870.

Leaving aside the papers and memoirs relating to pure and applied mathematics, and to natural history, this number contains the following original memoirs and communications relating to chemistry and collateral sciences:—

Action of Water upon Iron, and of Hydrogen upon Oxide of Iron.—H. Sainte Claire-Deville.—The author relates, at great length, a series of experiments which may be summarised as follows:—Perfectly pure iron, kept at temperatures varying from 150°—1600°, is treated with vapour of water of a known tension and temperature. Under these conditions, the following results are obtained, which prove that the decomposition of vapour of water by iron, while red-hot, is rigorously subject to all the laws which govern the tension of saturated vapours. The author states that, according to his experience, all changes of the state of aggregation must be strictly analogous, because the predominating phenomenon in all is the evolution or absorption of latent heat.

Fire-Clay made Stoves manufactured by MM. Muller and Co., Ceramic Manufacturers at Ivry.—General Morin.—The author states that the experiments made with these stoves at the Conservatoire des Arts et Métiers are highly satisfactory. The useful effect of heat given off by the fuel (coke) amounts to 0·93 per cent. The air in the rooms where these stoves were placed was not at all vitiated so as to incommode those present, notwithstanding the interior of the stoves (that part wherein the fuel is placed) became thoroughly red-hot. The author says that, taking all in all, these stoves, when suitably connected with flues, will afford a cheap, and, in every respect, wholesome mode of heating apartments.

On the Hail which Fell at Paris during a Thunderstorm on the 22nd of May last.—A. Trécul.—It appears that a heavy thunderstorm took place, accompanied by hailstones of extraordinary size (2 centims. by 1½) as well as shape (pyriform). A portion of most of them was, as usual, opaque; but a great many were partly opaque, and partly transparent and crystalline, in a peculiar and (for water) very unusual shape. Dr. Chapelas states, in relation to the storm alluded to, that it stands, according to his observations, in a very intimate relation to the Aurora Borealis seen on the 20th of May, and then accompanied by peculiar perturbations of the instruments applied for meteorological observations.

Report on a Memoir written by Dr. Vétillart, "On the Vegetable Fibres Applied to Industrial Purposes."—Professor Chevreul.—This lengthy paper gives a brief outline of the extensive researches made on flax, hemp, cotton, jute (*Corchorus capsularis*), China grass (*Urtica utilis*), and New Zealand flax (*Phormium tenax*). Owing to the importance of the contents of this paper, wherein very accurate and readily executed tests are given for the purpose of detecting the kind of various vegetable fibres, we intend to give a more extended account of the memoir at a future time.

On the System of the Mineral Lodes of the Hundsrück.—A. Vézian.

Compressibility of Gases under High Pressure.—L. Cailletet.—The author has studied the variation of compression of air and hydrogen between 1 and 800 atmospheres. Up to 80 atmospheres' pressure, air is more compressed than it should be if it followed the law of Mariotte; and at 680 atmospheres' pressure it only occupies two-thirds of the space which it ought to do theoretically. The method by which the author is enabled to measure the volumes occupied by a gas in an opaque apparatus is very simple. The glass tube is enclosed in an iron one, the former, containing the gas, is lightly gilt. The mercury, which serves for the transmission of pressure, whitens the gold, leaving a well-defined mark on it after the pressure ceases.

Combinations of Protochloride of Platinum and Oxide of Carbon.—Dr. J. Schützenberger.—The author describes three new compounds, viz.:—$COPtCl_2$, chloroplatinate of carbonyle, the most stable of these bodies, fusing at 194°; $C_2O_2PtCl_2$, chloroplatinate of dicarbonyle, fuses at 142°; $C_2O_2Pt_2Cl_4 = COPtCl_2 + C_2O_2PtCl_2$, a compound of one molecule of each of the preceding bodies, fusible at 130°. Water decomposes these substances instantaneously, platinum being set free and chlorhydric and carbonic acids formed, or, also, sometimes a mixture of carbonic acid and carbonic oxide. Alcohol also decomposes these substances.

Action of Acetylen upon Mixed Aceto-Hypochlorous Anhydride (Acetate of Chlorine).—M. Prudhomme.—The author describes, at length, a series of experiments, resulting in the discovery of a body—

$$\left.\begin{matrix} C_2H_2 \\ \text{iv} \\ 2(C_2H_3O) \\ Cl_2 \end{matrix}\right\} O_2,$$

that is to say, the aceto-chlorhydrine of a tetratomic alcohol.

Action of Sulphuric Anhydride upon the Protochloride and Sesquichloride of Carbon.—M. Prudhomme.—With the protochloride of carbon, C_2Cl_4, anhydrous sulphuric acid yields, on being heated in a sealed tube to 150°, sulphurous acid and chloride of trichlorated acetyl, $2(C_2Cl_4) + S_2O_6 = 2(C_2Cl_4O) + S_2O_4$; with the sesquichloride of carbon, $C_4Cl_6C_2$, the same body, and, in addition thereto, oxychloride of sulphur, $S_2O_5Cl_2$, is obtained, $C_4Cl_6 + S_4O_6 = C_2Cl_4O + S_2O_5Cl_2$.

Observations on the Batswing-Burner Flame.—A. Baudrimont.—The chief point of interest is that the aforesaid flame consists of two distinct portions, one of which (the interior) has a comparatively low temperature, while it is surrounded by a luminous envelope, the temperature of which exceeds that of molten platinum. Indeed the author found that a platinum wire 1-10th m.m. thick, when properly placed in this flame, fused immediately.

Two Instances of Upheaving of the Soil recently noticed.—Dr. de Botella.—The author, writing from Madrid to M. Elie de Beaumont, states that the steeples of the villages of Benifarzes, and the entire village of Salduende, have been considerably lifted up (upheaved), since 1847, in a direction nearly parallel to the system of the Saucerrois. The extreme distance between the upheaved points is 300 kilometres. The celebrated geologist to whom this communication is made said, at the meeting, that something similar was observed some years ago in the Kingdom of Wurtemberg, and that it is very probable that, if well conducted observations in this direction are set on foot, many such facts will come to be noticed.

Zeitschrift für Chemie von Beilstein, No. 8, 1870.

This number contains the following original papers, nearly all of which were read at the Imperial Russian Chemical Society, at the late meetings of that Society:—

Nitro Compounds.—A. Engelhardt and P. Latschinoff.—The chief object of this very lengthy paper is to prove that the so-called nitro-compounds, which are usually considered to be products of a metaleptic displacement of hydrogen by the nitro group NO_2, so that the chemical functions of the bodies which undergo this substitution remain the same, are really so altered, as regards their properties and characters, as if the body in which the substitution took place was oxidised. The authors have made a lengthy series of experiments to prove their statement; and the paper is divided into the following sections:—Nitrophenols and benzols; action of pentachloride of phosphorus on ortho-nitrophenol; phosphoric acid ortho-nitrophenol, $[C_6H_4(NO_2)]3PO_4$; action of PCl_5 upon volatile nitrophenol; nitro chlorobenzols; nitrobichlorobenzols; binitro-phenol and binitro-chlorobenzol; binitro-bichlorobenzol; trinitro-phenol and trinitro-chlorobenzol. The authors classify the nitro compounds of phenol

according to their behaviour with PCl_5, and also according to the properties of their chloranhydrides and amides, in the following manner:—

	Chloranydrides.	Amides.
Phenol.	Chlorobenzol.	Aniline.
Ortho-nitrophenol.	α Nitro-chlorobenzol.	β Nitraniline (Hoffmann's).
Volatile nitrophenol.	β Nitro-chlorobenzol.	
Dinitrophenol.	Dinitro-chlorobenzol.	Dinitro-aniline.
Trinitrophenol.	Trinitro-chlorobenzol.	Trinitro-aniline.

In this grouping, the acid character of each succeding compound becomes stronger.

Butylen.—A. Butlerow.—The main gist of this paper is to establish the author's priority of certain researches made by him, and the correction of some errors committed by Dr. Markownikoff in his paper published in the Russian language on butylen.

Preparation of Trimethyl-Carbinol from Isobutyl-Alcohol.—A. Butlerow.—Iodisobutyl is first prepared by passing HI into boiling butylic alcohol. This substance is next employed for the preparation of butylen in the following manner:—4 parts of potassic alcohol (consisting of 1 part of KHO and 3 parts of alcohol 90 per cent), 1 part of solid caustic potassa, and 2 parts of iodisebutyl are mixed and gently heated. The butylen (a gas) is collected in a gas-holder, after having been washed with alcohol and water. The butylen is converted into trimethyl-carbinol by a complicated process, based upon the complete absorption of butylen by sulphuric acid (3 parts H_2SO_4 and 1 part H_2O), and its conversion thereby into a liquid which, after saturation with K_2CO_3, and distillation, yields the compound in question.

On Isomeric Dibromotoluols.—E. Wroblevsky.—The author's researches have been made with the view of obtaining compounds different from those obtained by Dr. Fittig by the direct action of bromine upon toluol. For this purpose, solid toluidine was brominated, and the product converted into azoperbromide, $C_7H_6BrN_2Br_3$; and this substance made the starting-point for the preparation, first, of dibromotoluol, $C_6H_3Br\beta Bro.CH_3$, a liquid not solidified even at −20°, boils at 239°, sp. gr. 1·812 (at 19°), soluble in alcohol, and yields, when nitrated, only one nitro-dibromotoluol, $C_7H_3(NO_2)Br\beta Bro$, a solid crystalline substance fusing at 87°. The author further describes—Dibromotoluidine; another dibromotoluol, C_7H_6BroBr; dibromonitrotoluol; dibromotoluidine; nitro α bromtoluol; nitro o bromtoluol; and nitro-β iod-o bromtoluol.

Products of Decomposition of Glycogen by Sulphuric Acid.—Dr. A. Stscherbakoff.—After referring to Dr. Tichanowitsch's work on the origin of the hydrates of carbon within and without the animal organism, published, in the Russian language, at Cherikow, the author describes a series of physiologico-chemical experiments, the main result of which is that the composition of glycogen is to be expressed by $C_{30}H_{50}O_{25}$.

Preliminary Notice on a New Valerianic Acid.—A. Butlerow.—The author states that he has succeeded in obtaining from trimethyl-carbinol a valerianic acid—

$$\begin{array}{l} C(CH_3)_3 \\ | \\ COHO. \end{array}$$

Explanation of the Action of Peroxide of Manganese upon Chlorate of Potassa in the Preparation of Oxygen.—Dr. G. Krebs.—The utility of mixing peroxide of manganese, for which, however, may be substituted substances such as peroxide of iron, oxides of zinc and tin, burnt gypsum and others, provided they are previously well dried (best by ignition) with chlorate of potassa, is based upon the fact that the substances alluded to, which are infusible by themselves, are the carriers and transferrers of heat to the chlorate of potassa, each particle of which is surrounded with a source of heat, which aids its rapid decomposition. The peroxide of manganese is prevented from being itself decomposed, because the chlorate of potassa withdraws from it heat, for the purpose, first, of its own fusion, whereby heat becomes latent; secondly, by its decomposition. The author states that, when oxide of iron, or peroxide of manganese, are strongly heated in a crucible, and chlorate of potassa, very gently fused at the same time, by itself, in a porcelain dish, the addition of the hot (not red-hot) oxides to the fused chlorate causes the evolution of oxygen to set in instantaneously, and with so great violence that, unless this experiment be performed in open vessels, and with small quantities at a time, serious explosions may occur.

American Journal of Pharmacy, May, 1870.

Leaving aside the bulk of those original papers which relate strictly to pharmacy, and which are very valuable, this number contains the following original papers relating to chemistry and collateral sciences:—

Pumpkin Seeds.—Benton G. Bosch.—The author's researches on this subject have proved that these seeds contain 75 per cent of an oily kernel and 25 per cent of husk. The oil, extracted by ether, resembles, in taste, olive oil. The kernel contains, moreover, an oleo resin, to which, the author believes, the efficacy of the drug is due; this principle he calls *cucurbutin*—it is an anthelmintic.

Active Principle of the Catalpa Bignonoides.—E. A. Rau.—The author has investigated the bark of this tree, rejecting the outer corky layer, by a process too lengthy to be described here. He found a crystalline substance, insoluble in water and dilute alcohol, best dissolved in ether and chloroform. This substance, also insoluble in dilute alkalies and acids, was found to be neutral and free from ash; the taste of this substance was found to be intensely nauseous and bitter. The author also found a glucoside, a tasteless resin, and tannin.

Sulphate of Lime, an Impurity in Tincture of Chloride of Iron.—Dr. R. Battey.—The author records that the pharmaceutical preparation alluded to often deposits long, slender, delicate needles, along with a yellowish precipitate. On investigating these crystals, he found them to be sulphate of lime; but there is no necessary connection between that substance and the yellowish deposit, the nature of which is not further alluded to.

Light Sulphate of Quinine.—L. Strehl.—The author, writing from Chicago, U.S., reports that a small parcel of quinine was recently purchased there, labelled "light sulphate of quinine," manufactured by Lord, Bros., Ludgate Hill, London. That firm being unknown, the "quinine" was submitted to the ordinary tests for purity, and was discovered to exhibit a rhombic, prismatic, crystalline structure, taste bitter, entirely soluble in cold water, no indications of the presence of quinine with chlorine-water and ammonia, nor also with the former and ferrocyanide of potassium, and afterwards a few drops of ammonia. No sulphuric acid was detected, but, instead thereof, hydrochloric acid. All the reactions made confirmed the idea that, instead of the substance being sulphate of quinine, it was hydrochlorate of cinchonine. That salt resembles closely, in appearance, sulphate of quinine, and is a substitution which might readily pass unnoticed.

Remarks on Granular Citrate of Magnesia.—H. C. Archibald.—After referring to the so-called citrate of magnesia of the English trade, which the author states to be made up of tartaric acid, bicarbonate of soda, sugar, and a trace of magnesia, the author states that, to obtain a preparation that could be properly called granular citrate of magnesia, by the direct union of citric acid and magnesia, and having, at the same time, effervescing properties, was found to be impracticable. After a series of experiments to ascertain whether a granular salt could be made which would contain citrate of magnesia, and be at the same time effervescent and perfectly soluble, the following formula was adopted, which, if strictly adhered to, will afford a beautiful salt, possessing decided laxative properties and very acceptable to the palate:—Take of powdered citric acid, 4 lbs.; calcined magnesia, 1½ lbs.; bicarbonate of soda, 3 lbs.; tartaric acid, 3 lbs.; powdered white loaf sugar, 6 lbs.; essential oil of lemons, ½ fluid oz.; alcohol (very strong), *q.s.* To the powdered citric acid add the sugar, and mix thoroughly; then add the soda, magnesia, and tartaric acid. Pass the whole through a No. 40 sieve three times, to insure thorough mixture; moisten the powder with strong alcohol and pass through a No. 8 sieve and place on a wooden tray to dry, at a temperature of 120° F. Add the oil of lemons when dry, and bottle instantly in well dried and clean bottles. This preparation can be kept indefinitely without injury, is freely soluble in water without residue, has a pleasant taste, and is in very great request in the United States; undoubtedly, this preparation is far to be preferred above what goes by the name of effervescing citrate of magnesia in this country.

On a Brown Hair-Dye.—G. McDonald.—Under this title the author, in reality, makes known a fact which is worthy of notice; he says, the well-known fact that a soluble compound of lead and sulphur could not be obtained by the decomposition of a soluble lead salt by a soluble sulphuret, or, in other words, the insolubility of the sulphuret of lead was regarded as an indubitable proof of the folly of undertaking to search for a compound containing sulphuret of lead in a soluble state, and yet so as to be innocuous to the system. There is a class of salts known as hyposulphites, many of which are freely soluble in water, and which are readily converted by absorption of oxygen into sulphate of the base and free sulphur; it is in the use of these salts that the key to the enigma lies. Chemical text-books state that hyposulphite of lead is insoluble in water, which is quite correct; but, like many other precipitates insoluble in water, it is readily dissolved by an excess of the precipitant; thus, if we add to a solution of *three* parts of acetate of lead *two* parts of hyposulphite of soda, we shall have a curdy white precipitate of hyposulphite of lead, insoluble in water; but if we add to this *ten* parts more of hyposulphite of soda the precipitate will be re-dissolved, and a perfectly clear solution will be the result; this solution, when applied to the hair, is decomposed by absorption of oxygen; one of the results thereof is the formation of the dark brown sulphuret of lead, it is to the formation of this compound in the hair that all lead and sulphur dyes owe their efficacy.

Cosmos, May 21, 1870.

Reorganisation of the Ministry of Public Instruction.—By a decree, dated May 15th, M. Mège, Bâtonnier de l'Ordre des Avocats at Clermont Ferrand, has been appointed Minister of Public Instruction. This gentleman was born at Riom, September 15th, 1817; by a decree of the same date, there has been established a Ministry of Literature, Sciences, and Fine Arts, and a series of institutions, hitherto under the control of the Minister of Public Instruction, and among these the Imperial Institute, several libraries, and schools, have been placed under the newly established ministry.

Discovery of Fossil Bones near Durfort (Gard).—Cazalis de Foudouce.—The author, while on his way to Boumadas Morts, had his attention attracted by what appeared at some distance to be an elephant's tooth laying on a heap of stones, along the road from Alais to Vigan; on approaching the object he found it to be what he believed, and on making inquiry with the Cantonnier (men stationed along the road during a portion of the day, to see to its being kept in proper repair; they are under the orders of the Ingénieurs des Ponts et Chasseurs) the stones (intended for the repair of the road) were traced to their origin; upon search being made near that spot, a tolerably complete skeleton of the *Elephas primigenius* was found in a locality where,

judging by its well-known geological features, this was hardly to be expected; the author relates at great length all the particulars, including the size of the parts of the animal recovered.

Chemical Treatment of Flax.—M. Magne.—The author treats this fibre alternately with weak caustic alkalies and alkaline hypochlorites, at temperatures ranging from 20° to 50°; the last trace of alkali is washed out with weak hydrochloric acid; the fibres thus prepared are stated to be bleached better than by any other process.

Testing Glue for its Good Quality.—Dr. Chabrier.—The author states that the best means of ascertaining the goodness of glue consists in estimating the quantity of pure gelatine it contains, and for this purpose he suggests the use of a solution of pernitrate of mercury in water acidulated with nitric acid; the operation is carried out volumetrically, the solution of mercury salt being titrated with a solution of pure gelatine in known quantity dissolved in water.

May 28, 1870.

New Electro-Magnetic Apparatus.—Dr. Demazet.—The author describes, at length, an apparatus constructed by him, which appears to be an improvement of Siemens's; while making from 250 to 280 revolutions a minute, the lifting power of the magnet is 70 kilos., and under similar conditions a platinum wire, 0·8 m.m. thick and 20 centim. long, was rendered red-hot, and iron wire of the same thickness fused; the machine produces, per second of time, half a c.c. of gas by the decomposition of water.

Acclimatisation of the Eucalyptus Globulus.—Dr. Cloëz.—The tree alluded to, a native of Tasmania, is highly esteemed, both on account of the durability of its wood, which is very hard and superior to teak wood, and because its leaves contain a peculiar camphor-like essence, which dissolves caoutchouc more readily than sulphide of carbon does, and is also a solvent for copal; the tree is reputed to have febrifuge properties, because it is said that fever is never known where it is abundantly found. The neighbourhood of Paris is too cold, and the soil not suitable for its growth there; but in the southern parts of France, as well as in Spain (where the tree thrives well) this beautiful plant will be very useful as a forest tree; it reaches in its native clime enormous height and size.

Revue Hebdomadaire de Chimie, May 12, 1870.

Echardonnage of Wool by Chemical Means.—Dr. Schaller.—By *échardonnage* is understood an operation intended to destroy in wool the particles of straw and vegetable fibre accidentally adhering to it or left in it after having been treated with the teazle, still used sometimes in preference to the carding machine. The author impregnates the wool with a mixture of common salt and dilute sulphuric acid; the excess of this liquid is squeezed out between properly arranged cylinders, and the textile fibre is next exposed to a heat of 130°, which, aided by the hydrochloric acid evolved from the mixture above named, causes the carbonisation of the cellulose, leaving the wool untouched; this latter is next washed in a slightly alkaline liquid, and is then fit for the mechanical operations required before spinning the wool.

Manufacture of Red Lead from Nitrite of Lead.—M. Pichon.—After referring to the fact that the red lead (minium) of commerce almost always contains some metallic lead and some oxide of lead (massicot), incompletely oxidised, the author proposes to take nitrate of lead and granulated metallic lead in the proportions of one equiv. of nitrate to four of metal; these materials are placed in a cast-iron cauldron, lined inside with lead; water having been added, the mixture is heated to 60° or 80°; after two hours time a yellow sandy mass is found to have settled at the bottom of the vessel; the liquid should then be decanted into a leaden vessel, wherein the nitrite of lead soon crystallises; after the crystals have been drained they are decomposed by means of heat, by being placed for that purpose into retorts similar to those in use for the manufacture of nitric acid; the acid vapours given off are condensed by suitable means, and the oxide of lead, which is deep black coloured and perfectly homogenous, thus obtained is employed for the manufacture of red lead instead of massicot: the red lead thus produced is, according to the author, perfectly homogeneous, free from lead, and its composition is $3PbO_4+PbO_2$; there is a difference of opinion as regards the formula to be assigned to minium—PbO_2+2PbO (Dumas); Pb_3O_5,PbO (Winkelblech); $Pb_3O_5,4PbO$ (Longchamp); Pb_4O_5 (Mulder).

May 19, 1870.

Comparison between the Steam Generating Power of Coal when Burned, and of the Combustion of the Heavy Oils.—H. Sainte-Claire Deville.—This paper is a good abstract of the several papers which have appeared on this subject in the *Comptes Rendus*.

New Method of Copper Extraction, and its Separation from other Metals.—J. Elkington.—The principle applied by the author consists in applying electricity for dissolving the copper contained in the crude metal obtained by the usual smelting methods, and for depositing that metal galvanically upon plates of copper, causing the other foreign metals to fall to the bottom of the vessels in which the operations take place; copper, containing very small quantities of silver, may be advantageously treated thus for the recovery of the last-named metal.

So-called Annular Furnace or Kiln for the Continuous Operations of Burning Bricks, Lime, Porcelain, Cement, &c.—F. Hofmann.—Illustrated with woodcuts.

On the Salts of the Cerium Metals.—M. Zschiesche.—The author has studied some of the salts of the metals jointly found in the mineral cerite. Chloride of lanthanum, $LaCl+5HO$, forms large colourless crystals, which are not deliquescent; oxalic acid precipitates from acid solutions of didymium the oxalate of that metal in insoluble state similar to chloride of lead; on being heated to a redness it first yields a carbonate, and at a very high temperature a peroxide; the sulphate of didymium is $DiOSO_3+3HO$. Among the cerium salts the author studied the salt yielded by the oxide which results from the ignition of the oxalate of cerium; this oxide, when dissolved in sulphuric acid, yields a red-coloured salt—$5CeOSO_3+Ce_2O_3SO_3+27HO$: and a yellow-coloured mixture of the last and some sulphate of protoxide.

Oxyhydrogen Blowpipe, called Universal.—M. Delaporte.—The chief point of difference of arrangement in this apparatus consists in having several jets for the hydrogen, and only one for the oxygen; this latter gas, the heavier, is made to fall as it were and convey the other. The effect is the production of a lance-shaped flame of great power; proper precautions are provided to prevent explosions.

Analysis of the Water of the Grosmard Spring intended to Supply the Town of St. Guentin.—J. Vivien.—Ten litres of this water contain, in grms.:—Carbonate of soda, 0·0510; carbonate of lime, 2·3480; carbonate of magnesia, 0·1530; nitrate of lime, 0·4539; nitrate of magnesia, 0·0559; sulphate of lime, none; chloride of potassium, 0·2196; chloride of sodium, 0·1233; silicate of soda, 0·0371; free silica, 0·0170; organic matter, 0·0210; total, 3·3898.

NOTES AND QUERIES.

Phosphate of Ammonia.—Will any of your readers kindly furnish me with a process for the manufacture of phosphate of ammonia from bone-ash.—J. W. M.

Oxygenated Water.—Will any of the readers of the CHEMICAL NEWS oblige J. C. with the method and utensils adopted in the manufacture of oxygenated water, or say where he may gain such information?

Chrome Colour.—"Colourman" offers his best thanks for the answers given to his query. As *Dingler's Polytechniches Journal* is not within his reach, may he trespass once more by asking if a formula is given for producing a good vermillion-red chrome colour?

Erecting Prism.—Referring to Prof. Morton's very ingenious plan of erecting the image given by a magic lantern, I beg to inform you that I have made the prism (Fig. 2, p. 246 of the CHEMICAL NEWS) some two or three years since, for Prof. Herschel, of the Andersonian College, Glasgow; and I have one of these prisms by me at present.—JOHN BROWNING.

Volumetric Estimation of Chlorine.—In the CHEMICAL NEWS (vol. xxi., p. 217), I notice the estimation of chlorine by means of nitrate of silver and chromate of potassium solution. The process is by no means new; it can be found at p. 183 of Sutton's "Volumetric Analysis," 1863. I used the method in various instances as far back as 1864, with much success.—T. B.

Tungsten Blue.—In the CHEMICAL NEWS (vol. xxi., p. 130) appears an extract from *Les Mondes* relating to tungsten blue. Will any one of your readers be kind enough to inform me whether he has succeeded in making the blue according to the process there given, and, if so, state his opinion of its value? Says the extract, it "is sold at the same price as the very best quality of Prussian blue." May I ask where a sample can be purchased?—T. W. S.

MEETINGS FOR THE WEEK.

MONDAY, June 6th.—London Institution, 4.
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 7th.—Ethnological, 8.
—— Royal Institution, 3. Prof. Seeley, "On Present English History."
WEDNESDAY, 8th.—Microscopical, 8.
—— Geological, 8.
THURSDAY, 9th.—Royal Institution, 3. Prof. Tyndall, "On Electricity."
—— Zoological, 8.30.
FRIDAY, 10th.—Royal Institution, 8. Prof. Odling, "Ammonia Compounds of Platinum."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
SATURDAY, 11th.—Royal Institution, 3. Prof. Grant, "Astronomy of Comets."
—— Quekett Microscopical Club. Excursion to Elstree. To meet at St. Pancras Station, at 1.30 p.m.

TO CORRESPONDENTS.

F.C.S.—We think it may.

T. Summers, jun.—1. The full account will be found in the *Bulletin de la Société d'Encouragement* for 1869, 2e serie, t. xvi., p. 277. Apply to Asher and Co., Bedford Street, Covent Garden. 2. We know of no work devoted entirely to the subject; it is treated of in the Dictionaries of Chemistry.

THE CHEMICAL NEWS.

Vol. XXI. No. 550.

NOTE ON THE

HOMOLOGUES OF CUPRIC ACETO-ARSENITE (SCHWEINFURT GREEN).

By P. S. ABRAHAM, B.Sc.,
Exhibitioner at the Royal College of Science, Dublin.

I have recently found that, if cupric formiate, butyrate, or valerianate be substituted for cupric acetate in the process for the manufacture of Schweinfurt green, compounds are obtained similar in colour to the well-known green, but containing formic, butyric, or valerianic acid in place of the acetic.

For the preparation of cupric formo-arsenite, 4 parts of cupric formiate were dissolved in as little water as possible, and added to 4 parts of arsenious acid dissolved in about 50 parts of water by the aid of a little caustic soda; both solutions being at the boiling-point. The yellowish precipitate which appeared soon became of a very bright green, with a slightly more yellowish tinge than the acetic compound.

The butyric and valerianic greens were made in a similar manner, but with different proportions of cupric salt and arsenious acid.

NEW METHOD OF HEATING STONEWARE VESSELS, AND OF OBTAINING REGULATED HIGH TEMPERATURES.

In conducting chemical and pharmaceutical operations for manufacturing purposes, it is generally necessary to effect evaporation and distillation in stoneware vessels; but great difficulty has been hitherto experienced in obtaining a sufficiently high temperature without cracking or breaking the pan employed. The use of a naked fire inevitably causes a fracture; and a sand-bath offers too great an obstruction to the passage of the heat. With a steam-jacket, it is impossible even to raise water to the boiling-point, unless, indeed, such a pressure of steam be applied as to cause a very dangerous strain on the flanges of the vessel.

A new method of applying heat, however, has been patented by Mr. J. A. Coffey, the pharmaceutical engineer, and is now introduced by Messrs. Doulton and Watts, for working stoneware pans and stills, by which any temperature ranging from 100° to 700° F. can be safely and easily obtained.

Mr. Coffey's principle is to cause heavy paraffin-oil to circulate, first through a coil of pipes in a furnace, and then through the jackets of the pans. The oil is carefully selected for the purpose, from the heaviest of the petroleum or paraffin products. It moves by its own convection. Heated in a close coil of pipe by a coke fire, it rises into an air-tight tank, from which it passes, through pipes, to the jackets of the different vessels to be heated, returning, after it has done its work, to the lowest part of the furnace-coil; a continuous circulation is thus maintained, similar to that which occurs in a hot-water apparatus for warming buildings. After leaving the tank, the oil passes through a pyrometer, by which its temperature is indicated, and, by means of dampers, &c., to the fire this can be regulated to any required point. The heating medium is turned on or off the jackets by taps, in the same manner as steam; and, as the rate of flow can be checked or augmented at will, the temperature is perfectly under the control of the operator.

In the model which has been fitted up at Messrs. Doulton and Watts's to illustrate the principle of this method of working, the pyrometer generally indicates from 600° to 700° F., while a saturated solution of chloride of calcium is maintained at the boiling-point in a shallow stoneware pan. No smell of oil is perceptible in the room; and it is stated that the same oil may be used for years, without deterioration or causing any deposit in the pipes. As contrasted with steam-heat, the inventor claims for his process a saving of 30 per cent in fuel. It is obvious that the large amount of heat necessary to convert water at 212° F. into steam at 212° is hereby economised. The stoneware used in this process is manufactured expressly by Messrs. Doulton, to ensure its being quite impervious to the oil.

Other applications of this method of conveying heat are included in Mr. Coffey's patent; but its easy adaptation to heating stoneware will probably be of the most interest to chemists.

AMMONIUM AMALGAM AND HYDROGENIUM.

By Prof. C. A. SEELY.

At the meeting of the Chemical Section of the New York Lyceum of Natural History, May 9th, 1870, Prof. C. A. Seely read a paper "*On the Constitution of Ammoniacal Amalgam*," of which the following is an abstract:—

Ammonium amalgam was discovered by Berzelius in 1808, and immediately after by Pontin, Seebeck, and Trommsdorff. Its easy preparation, singular properties, and its relation to current theories, have made it familiar to all chemists; it led to the adoption of Ampere's ammonium theory, gave a great impetus to the theory of organic radicals, and revived the notions of the alchemists of the compound nature of metals. Early in this century, it led many to conclude that the base of nitrogen is a metal; and, at the present time, without doubt, has assisted in giving currency to the notion that hydrogen is a metal. Except for it, perhaps the crudity, hydrogenium, would not have been inflicted upon us. Of course it has occupied a conspicuous place in chemical literature; scores of papers, and at least two books, have been printed about it.

The name ammonium amalgam expresses the supposed constitution of the substance; the radical ammonium is represented as dissolved in, or united with, mercury. The ammonium is, moreover, conceded to be a solid or a liquid, and to have a truly metallic character; thus the latest and best authorities present the case. It is described, in nearly all treatises on chemistry, as if its constitution was as certainly ascertained as that of common salt. There have been, from the beginning, however, those who doubted the prevailing ideas, and some (see Daniell's "Chemical Philosophy," p. 520; and Dr. Wetherill on "Ammonium Amalgam," in *Silliman's Journal*, vol. xl., p. 160) boldly objected to them; but the reasons they alleged had not sufficient weight. Ammonium amalgam has always been a pet with chemists; it has always been ready for the service of one theory or another. The ammonium theory, the radical theory, the nitrogen and hydrogenium theories, have each, in their turn, been of too much importance to permit any of their props to be withdrawn.

The author considers the so-called ammonium amalgam

to be a mechanical or physical mixture of liquid mercury with the gases ammonia and hydrogen, and that its semi-solid consistence is due to the mixture having the nature of a froth. When sodium amalgam is brought into a solution of sal ammoniac (the ordinary method of preparing ammonium amalgam), the chlorine combines with the sodium, and the residue (NH_3+H) of the sal ammoniac is set free all over the surface of the mercury; the particles of the mixed gases adhere to the mercury, and, by reason of the movement bringing to the surface fresh mercury, they become enfilmed and carried inward, until the mixture becomes a homogeneous froth. The principal considerations by which this view of the constitution of ammonium amalgam has been reached are as follows:—

1. The volume of ammonium amalgam is inexplicable in any other way. It is utterly inconsistent with the well-established laws of combinations by volume; there is no case of a liquid or solid chemical compound, or amalgam, which has any analogy to it.

2. Mercury has a mirror-like surface; while ammonium amalgam has comparatively a whiter and more dead surface: it approaches, in appearance, to matt silver. Such changes are characteristic of froths.

3. If ammonium amalgam be subjected to varying pressure, its volume changes, apparently, in accordance with Mariotte's law of gaseous volume. To illustrate this important fact, a glass tube, ¼ inch in diameter, 20 inches long, and fitted with a plunger, was employed. Mercury containing a little sodium was poured into the tube to ¼ inch in depth; and upon this was poured a strong solution of chloride of ammonium, occupying about 2 inches in length of the tube. The ammonium amalgam was completely formed in a few minutes, and occupies several inches of the tube. On adjusting and depressing the plunger, the volume of the amalgam progressively diminished till it closely approached the original volume of the mercury. Also, it was notable that the amalgam progressively gained fluidity and the mirror-surface, till, at the greatest pressure, it appeared like mercury. On withdrawing the pressure, the original volume and appearance of the compound were resumed; and, on reducing the pressure below that of the air, the amalgam still expanded, until it rose above the surface of the liquid in the tube. If the great pressure be maintained, more ammonium amalgam will be formed, the mass expanding progressively, apparently in accordance with the fact that the absorption or adhesion of gases to liquids is favoured by pressure. By means of the simple apparatus used, a pressure of ten atmospheres or a good vacuum are easily and at once obtainable, and the experiments with it are very striking.

The so-called ammonium amalgam is, therefore, not an amalgam at all. Ammonium is not proved to be a metal; and, if it be admitted that the monatomic radical really exists in ammonium amalgam, it is neither a solid nor a liquid, but a gas.

The considerations regarding ammonium amalgam are evidently equally applicable to Loew's hydrogenium amalgam; both are only metallic froths. The expansion of palladium observed by Graham, on its absorption of hydrogen, is probably analogous to the case in question. In both cases, the gases concerned are condensed, by reason of their attraction to the metal; and, if the molecules of palladium were made free to move, as those of mercury, it is probable that Graham's hydrogenium alloy would become a palladic froth, more remarkable than the corresponding mercuric froth. Many have erroneously supposed that hydrogen was conspicuous in its capability of being absorbed by metals, and thus have more readily been infused with the hydrogenium theory. Oxygen has an eminence over hydrogen in that property; and yet no one has a theory of oxygenium. Iron absorbs carbonic oxide; but no one is bold enough to suggest that carbonic oxide is a metal.—*American Gas-Light Journal.*

A PROCESS FOR QUICKLY AND ACCURATELY

DETERMINING THE AMOUNT OF CHROMIUM AND IRON IN CHROME IRON ORES.*

By J. BLODGET BRITTON,
Ironmaster's Laboratory.

Reduce the mineral to the finest state of division possible, in an agate mortar. Weigh off 0·5 grm. and add to it 4·0 grms. of a flux, previously prepared, composed of one part chlorate of potassa and three parts soda-lime; thoroughly mix the mass by triturating in a porcelain mortar, and then ignite in a covered platinum crucible at a bright-red heat for an hour and a half or more. The mass will not fuse, but when cold can be turned out of the crucible by a few gentle taps, leaving the interior of the vessel clean and bright. Triturate in the mortar again and turn the powder into a tall 4-oz. beaker and add about 18 c.c. of hot water, and boil for two or three minutes; when cold, add 15 c.c. of hydrochloric acid of common strength, and stir with a glass rod for a few minutes, till the solid matter, with the exception, probably, of a little silica in a flaky gelatinous state, becomes dissolved. Both the iron and chromium will then be in the highest state of oxidation—Fe_2O_3 and CrO_3. Pour the fluid into a white porcelain dish of about 20 ozs. capacity, and dilute with washings of the beaker to about 3 ozs. Immediately after, also, pour cautiously into the dish 1·0 grm. of metallic iron of known purity, previously dissolved in dilute sulphuric acid and further diluted with cold water to about 5 ozs., to make up the volume in the dish to about 8 ozs. (*I* use for the purpose fresh borings from a piece of bar iron, containing less than 0·05 of foreign matter, dissolved in 18 c.c. of dilute sulphuric acid of 1 part acid and 3½ parts water, in a tube 12 inches long and ¾ inch diameter, closed at the top with a gum stopper perforated for a ¼ inch tube, bent short round at right angles and extending horizontally about three or four inches, applying heat to expel atmospheric air and facilitate operations). When the iron is dissolved, and having tested the solution for sesquioxide, I nearly fill the tube with *cold* water and cautiously pour the contents into the dish and add about two tubes-full more of *cold* water to make up the solution to about 8 ozs., and then determine, volumetrically, with a standard solution of permanganate of potash, the amount of protoxide of iron remaining. The difference between the amount of iron found and of the iron weighed will be the amount oxidised to sesquioxide by the chromic acid. Every one part so oxidised will represent 0·320 of metallic chromium, or 0·4663 of sesquioxide, Cr_2O_3, in which last condition the substance usually exists in the ore.

If the amount of iron only in the ore is to be determined, the process is still shorter. After the fluxed mineral has been ignited and reduced to powder, as already directed, dissolve it in a tube of the kind described, by adding, first, 10 c.c. of hot water and applying a gentle heat, and then 15 c.c. of hydrochloric acid, continuing the heat to incipient boiling till complete decomposition has been effected; cool by immersing the tube in a bath of cold water, add pieces of pure metallic zinc (sheet zinc cut in small strips I prefer) sufficient to bring the iron to the condition of protoxide and the chromium to sesquioxide, and apply heat till small bubbles of hydrogen cease, and the zinc has become quite dissolved; then nearly fill the tube with *cold* water, acidulated with 1-10th of sulphuric acid, and pour the contents into the porcelain dish, add *cold* water to make up the volume to about 8 ozs., and complete the operation with the standard permanganate solution.

The process, if conducted as directed, affords very accurate results; upon repeating the determinations there should be practically no variation. The whole time

* Communicated by Professor Morton.

consumed need not exceed three hours to determine both the chromium and the iron, if the two ignitions are proceeded with simultaneously.

It need scarcely be remarked that fine iron wire or ammonio-protosulphate of iron may, in most cases, be used with greater convenience than borings. I, however, in my own practice, prefer the latter, and for several years past have kept in the laboratory for use a large piece of iron of the kind mentioned, from which, by the aid of a small foot-lathe, I obtain in a moment or two clean unoxidised borings whenever they are needed, and thus have an unalterable standard always at hand.

For dissolving minerals and metals, I constantly use tubes of the kind described, though sometimes of a larger size, preferring them generally to all other vessels for many reasons:—avoidance of loss of substance, convenience of rinsing, expulsion of air while digesting and boiling, carrying out of the laboratory all of the evolved gases by means of the small bent tubes leading into a chamber connected with the main chimney, &c.

When determining iron volumetrically with the permanganate solution, I also always use the cold water acidulated with sulphuric acid, when hydrochloric acid has been the solvent, because with it the final relation is more distinct and the results more constant; besides, if previously prepared in quantity, and cold, it at once reduces the temperature of the hot fluid, and so saves time.—*Journal of the Franklin Institute.*

ON THE

ESTIMATION OF PEROXIDE OF MANGANESE IN MANGANESE ORES.*

By JOHN PATTINSON, F.C.S.

It has long been known that very varying results have been obtained by different analysts in operating upon the same samples of manganese ore, and, very naturally, these discrepancies have been a source of great annoyance to both sellers and purchasers of these ores. In their attempts to find the cause of these differences, Messrs. Teschemacher and Smith were led to the discovery that many manganese ores now in the market contain magnetic oxide of iron. It is said that this substance appropriates a portion of the peroxide of manganese in the ore when the sample is tested by what is known as the iron method of estimation, but not when tested by Fresenius and Will's oxalic acid method; in other words, that the iron process indicates only the *available* amount of peroxide of manganese in the ore, and the Fresenius and Will process the *absolute* amount; and hence, they say, the differences in the results found by the various analysts who use these two methods. This theory may, possibly, be correct in some cases, but it is certain that this is not the only reason why the Fresenius and Will process gives higher results than the iron process in testing certain ores, I have met with several samples of manganese ore containing considerable quantities of magnetic oxide of iron, but I have never yet met with one the magnetic oxide of which was not fully oxidised at the expense of the peroxide of manganese of the ore on being tested by Fresenius and Will's method. Before proceeding further it will be desirable to consider what takes place when the Fresenius and Will test is applied in the presence of protoxide of iron. If the protoxide of iron is in the soluble state it is entirely peroxidised by the oxygen of the peroxide of manganese, and the test indicates a relatively less amount of peroxide in the ore examined. This was proved by the following experiment:—30 grs. of a soft and easily decomposed manganese ore free from magnetic oxide and known to contain by the Fresenius and Will test 63·36 per cent of peroxide, together with 70 grs. of neutral oxalate of potash, 20 grs. of proto-sulphate of iron containing 3·90 grs. of iron in the state of protoxide, and some water, were treated in the usual way according to the Fresenius and Will method. The percentage of peroxide indicated by the loss of carbonic acid was 53·13, showing that the protoxide of iron in the proto-sulphate had appropriated 10·23 per cent of peroxide. Theory requires 10·21 per cent of peroxide to effect the oxidation of all the iron. The effect is different when the protoxide of iron in the ore is in the insoluble state, as, for instance, when magnetic oxide is present. In this case the protoxide is only peroxidised as it becomes dissolved. It is possible that ores containing magnetic oxide may exist which have their peroxide in a condition in which it is so easily decomposed by oxalic acid that the whole may be decomposed before the magnetic oxide has been at all dissolved, In this case the test would indicate the *absolute* amount of peroxide in the ore. That such a condition may obtain is seen by the following experiment:—25 grs. of an ore similar to that used in the last experiment but containing 63·60 per cent of peroxide by both the iron and oxalic acid tests, together with 60 grs. of neutral oxalate of potash, 5 grs. of very finely-powdered magnetic oxide of iron known to contain 18·6 per cent of iron as protoxide, and some water, were placed in the Fresenius and Will apparatus. On testing in the usual way, the loss of carbonic acid indicated 63·50 per cent of peroxide, or within 0·1 of a per cent of what it was without the magnetic oxide. The magnetic oxide, however, was apparently but very slightly, if at all, affected. A further quantity of sulphuric acid was then added, and heat applied until the solution of the magnetic oxide was completed. The amount of iron existing in the solution was then determined by a standard solution of bichromate of potash. It indicated 1·08 grs. of iron in this condition. The amount in the five grains of magnetic oxide was 0·93 grs. The excess is accounted for by the fact that the oxalic acid in the solution somewhat interferes with the bichromate of potash test for iron.

I have said it is possible that ores of the character described above may exist—ores in which the Fresenius and Will test will indicate the absolute amount of peroxide they contain; but I have never met with such ores. Those I have seen containing magnetic oxide of iron (and some samples have contained a considerable amount) have had this substance so intimately diffused throughout the ore, and have had their peroxide in a condition so difficult to decompose, that the magnetic oxide has been quite dissolved before, or as soon as the complete decomposition of the peroxide has been effected. This was easily proved by testing the resulting solution of manganese and iron for protoxide of iron by means of a few drops of a solution of red prussiate of potash added to the dilute solution. It it obvious that, if after completed decomposition of the ore, the manganese has not peroxidised the whole of the protoxide of the magnetic ore, its presence would be detected by the above test. *In no case have I found any proto-salt of iron in the resulting solutions.* Therefore, in all the cases I have met with, some of the peroxide of the ore has been appropriated to completely peroxidise the magnetic ore, and the Fresenius and Will test, in these cases, does *not* indicate the absolute amount of peroxide contained in the ores.

In my opinion, the more likely explanation of the cause of the discrepancies between the various tests is to be found in the great difficulty with which these hard ores containing magnetic oxide of iron are decomposed in the Fresenius and Will apparatus. In order to effect their decomposition it is necessary to add a large quantity of sulphuric acid, and to apply extraneous heat for a considerable time. It is probable that, during this lengthened heating, steam is allowed to escape with the carbonic acid, and hence a higher amount of peroxide is indicated than is present in the ore.

* Read before the Newcastle-upon-Tyne Chemical Society, January 27, 1870.

But whichever theory is correct, both lead to the same conclusion that with such hard ores the Fresenius and Will test gives inaccurate results, and therefore should be abandoned. For soft and easily decomposed ores I believe its indications are very correct; but as several of the other class of ores are now in the market, it is necessary to have some process by which the available peroxide contained in all kinds can be correctly determined.

The iron process is one which is now in very general use, and has usually been found to give very good results.

In the paper "On the Estimation of Peroxide of Manganese in Manganese Ores," by Messrs E. Sherer and G. Rumpf, read before the members of this society at their meeting in November last, these gentlemen show that they had obtained inaccurate and irregular results in their experiments with this method as followed by them. They had used pianoforte wire dissolved in a flask with hydrochloric acid, adding the manganese ore in a glass tube, and taking the precaution of keeping an atmosphere of carbonic acid in the flask during the whole process to prevent oxidation by atmospheric air. They attributed the irregularity of the results they had obtained, and correctly I think, to the circumstance that portions of the manganese ore are occasionally floated to the surface of the solution where they evolve chlorine, which escapes without coming into contact with the proto-salt of iron in solution. That this process can be made to yield correct results, by taking precautions to prevent this escape of chlorine, the authors themselves have shown. Fresenius also states in his handbook that the results he obtained by this process agreed exactly with those obtained by that of Fresenius and Will. Messrs. Sherer and Rumpf come to the conclusion that, of the methods they experimented with, Bunsen's gave the most correct results, and that this method was much simpler and shorter of execution than the iron method when the necessary precautions to insure accuracy were employed in the latter process.

In the discussion which followed the reading of this paper I stated that, being aware of the source of error the authors had pointed out, I had, for some time past, used in my laboratory a modification of the iron process by means of which the source of error was avoided, and perfectly accurate and concordant results obtained; and that the modified process was, in my opinion, more easy of execution (requiring less skill and care at the hands of the operator) than the Bunsen method of estimation. In fulfilment of a promise I then made I have now to describe the manner in which I proceed when testing manganese ores by the iron method.

30 grs. of clean iron wire are placed in a 20 oz. flask, along with 3 ozs. of dilute sulphuric acid, made by adding 3 parts of water to 1 of oil of vitriol. A cork, through which passes a tube bent twice at right angles, is inserted in the neck of the flask, and the flask is heated over a gas flame until the iron is dissolved. The bent tube is placed so as to dip into a small flask or beaker containing a little water. When the iron is quite dissolved, 30 grs. of the finely-pounded and dried sample of manganese ore to be tested are put into the flask, the cork replaced, and the contents again made to boil gently over a gas flame until it is seen that the whole of the black part of the manganese is dissolved. The water in the small flask or beaker is then allowed to recede through the bent tube into the larger flask, more distilled water is added to rinse out the small flask or beaker and bent tube, the cork well rinsed, and the contents of the flask made up to about 8 or 10 ozs. with distilled water. The amount of iron remaining unoxidised in the solution is then ascertained by means of a standard solution of bichromate of potash. The amount the bichromate indicates, deducted from the total amount of iron used, gives the amount of iron which has been peroxidised by the manganese ore, and from which can be calculated the percentage of peroxide of manganese contained in the ore. Thus, supposing it were found that 4 grs. of iron remained unoxidised, then 30 − 4 = 26 grs. of iron which have been oxidised by the 30 grs. of ore. Then, as

Iron.		Peroxide of Manganese.		Iron.		Peroxide of Manganese.
56	:	44	::	26	:	20·43

the amount of peroxide in the 30 grs. of ore. The percentage is, therefore, 68·10.

It will be seen, from the above description, that the only differences between this method and that usually described in hand-books are the use of sulphuric acid instead of hydrochloric acid, and the dispensing with the use of a stream of carbonic acid. These alterations, however, enable us to get rid of the source of error indicated by Messrs. Sherer and Rumpf, and also of the somewhat complicated and troublesome apparatus required to supply a stream of carbonic acid.

In order to determine the accuracy of this method, some samples of soft and easily-decomposed manganese ore known to be free from magnetic oxide, were tested by Fresenius and Will's method, and compared with the results obtained by the iron method. The results obtained were as follows:—

By Fresenius and Will's Process.	By Iron Process.
63·36 per cent	63·43 per cent
82·34 ,,	82·34 ,,
74·00 ,,	73·98 ,,
63·32 ,,	63·25 ,,

That by the iron method results can be obtained which agree very closely with each other will be seen by the following statement:—Of 85 samples tested in duplicate by this method 22 were exactly the same in the two results, 54 were within 0·1 of a per cent of each other, 8 were within 0·2 of a per cent, and 1 differed 0·2 of a per cent in the two tests.

The use of sulphuric acid instead of hydrochloric acid not only gets rid of the before-mentioned source of error, but it is also the reason why the carbonic acid atmosphere can be dispensed with. I have ascertained that the solution of iron in sulphuric acid does not oxidise appreciably by exposure to air within any reasonable time; certainly not within the time required to make the test. A sample of manganese ore tested after allowing the iron solution to cool in an atmosphere of carbonic acid, and taking precautions to prevent the admission of air, indicated 63·98 per cent of peroxide by two separate tests. Another portion of the same ore was tested after another portion of iron had been simply allowed to cool in air and to stand one hour before adding the manganese ore. It indicated exactly the same as the sample cooled in carbonic acid, viz.:—63·98 per cent. Another sample, after the iron solution had been allowed to stand two hours exposed to the air, still indicated 63·98 per cent of peroxide. After 19 hours' exposure of another portion the ore indicated 63·96 per cent. There was, therefore, no practical difference in the amount of iron existing as protoxide in any of these solutions. In another experiment a sample of manganese ore, which had indicated 64·45 per cent of peroxide on cooling the iron in carbonic acid, indicated 64·50 per cent after the iron solution had been exposed to the air for six hours, and 64·69 per cent after the iron solution had been exposed to the air during 48 hours. In the last case the iron had become oxidised to a slight extent, but in the case of the iron exposed for six hours little or no oxidation had occurred.

The same results have been repeatedly obtained in other experiments.

The solution of iron in hydrochloric acid oxidises much more rapidly. 7 grs. of iron wire dissolved in hydrochloric acid, and allowed to stand 18 hours exposed to the air in a flask with a cork through which passed an open tube, indicated 6·2 grs. of iron existing as a proto-salt; whilst 7 grs. dissolved in sulphuric acid, and exposed for the same length of time, under the same circumstances, indicated 6·995 of iron existing as a proto-salt.

The kind of iron wire I have found to answer best for these analyses is the kind used by wire-workers, and known as "annealed iron wire." Only the purest qualities of iron are used for wire of this description. I have carefully examined it by comparing it with pure oxalic acid and pure bichromate of potash, as well as by heating it in an atmosphere of chlorine, and find that it is within about 0·1 of a per cent of being absolutely pure. For all practical purposes of testing it may, therefore, be considered pure. There is no difficulty in obtaining it in large quantity and of uniform quality. I have tested wire of this kind of such thickness that 22 wires laid close together cover an inch, and I find it of equally pure quality as that which requires about 85 wires to the inch. I prefer the latter because it is more easily cut and dissolved, and it is more likely to be pure. Pianoforte wire, which is made of steel, will not do, excepting a correction is made for the amount of carbon it contains. I have found wire of this kind which contains only 98·50 per cent of pure iron. The odour of the hydrogen evolved during solution is a good indication of the purity of the iron. With steel wires the odour of carburetted hydrogen is very strong, but with the annealed iron wire it is very slight. In all cases it will be desirable to ascertain the purity of every new batch of iron wire obtained previous to its being used for testing manganese ores. Having once obtained wire of known purity, all future batches may be most easily and correctly tested by comparing the amount of peroxide of manganese, and, consequently of iron, indicated by a certain ore when tested by the new wire with the amount indicated when tested by the wire of known purity. The wire is easily cleaned from all adhering oxide and dirt by passing it a few times through fine emery paper and afterwards through a cloth. It is dissolved by the sulphuric acid in about fifteen minutes. I do not like to use crystals of protosulphate of iron, nor of the double sulphate of iron and ammonia, on account of the uncertainty of their composition. I have never yet met with either of these in so pure a condition as the iron wire. Besides there is no advantage in their use. It is quite as easy to weigh the iron wire as to weigh crystals of protosulphate of iron. I have tried a standard solution of protosulphate of iron, but find it does not keep sufficiently well to make it worth while to use this.

The use of the small flask or beaker in connection with the bent tube is to prevent all loss of iron by its being carried over with the hydrogen and steam. I have, occasionally, found a slight trace of the iron thus carried over through the tube, but this is, of course, all arrested by the water in the small beaker or flask, and is again returned into the larger flask when the tube is rinsed out.

The length of time required to decompose the manganese ore depends upon the hardness of the sample under examination, and this mode of testing thus affords a good indication of the nature of the ore in this respect. Soft ores will be decomposed in a minute or two, whilst very hard ores require fifteen minutes or more. The decomposition can be hastened by adding more oil of vitriol, but this must be done after the iron is dissolved, as the latter does not readily dissolve in stronger acid than that I have mentioned.

The standard bichromate of potash solution I use is made so that 1000 fluid grains will peroxidise 10 grains of iron. It is applied to the diluted solution in the usual way.

If there is reason to suppose that the ore to be tested contains more than about 78 per cent of peroxide, it will then, of course, be necessary to use less than 30 grs. of ore or more than 30 grs. of iron; as these quantities are only intended for ores of a lower percentage than about 78.

In order to facilitate and check the calculation of the percentage results, I have a table drawn up which shows the various percentages in the ores corresponding to every five grains of the bichromate solution, based upon the assumption that 30 grs. of iron and 30 grs. of ore are used.

In conclusion, I have to say that, with respect to the Bunsen method of estimation, it has given me unsatisfactory and variable results so far as I have tried it. I have, however, not yet completed my investigations into this method.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 2nd, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

MR. W. B. TUSTIN was elected a Fellow.

Professor ODLING, F.R.S., delivered a lecture "*On the Platinum-Ammonia Compounds.*" The lecturer made by way of preface the following remarks:—One atom of platinum combines with four atoms of chlorine to form platinic chloride, $PtCl_4$. In another compound of platinum and chlorine the latter is just one-half of that in platinic chloride, and this platinous chloride may be represented either by the formula Pt_2Cl_4 or by $PtCl_2$. Dr. Odling assumes the latter one to be correct, observing, on this occasion, that in chemical theory any assumption may be made, provided it is kept always in mind that it is only an assumption. All platinum-ammonia compounds are produced in the first instance from $Pt\,Cl_2$,—none of them directly from $PtCl_4$. Just like platinous chloride is, through direct combination with chlorine, transformed into platinic chloride, so the platinous ammonia compounds, by direct union with chlorine, form platinic ammonia compounds. This view will at once introduce simplicity in the study of these compounds. The lecturer next proceeded to consider the right manner of expressing the constitution of sal-ammoniac. The decided analogy of this salt with potassium boro-fluoride, $BF_3.KF$; potassium silico-fluoride, $SiF_4.K_2F_2$, and potassium platinochloride, $PtCl_4.K_2Cl_2$, as well as many other evidences, do not permit to represent sal-ammoniac as NH_4Cl, that is

$$\underbrace{H\,H\,H\,H\,Cl}_{N},$$

as if by union of hydrochloric acid with ammonia the chlorine would leave its hydrogen in order to combine with nitrogen,—a supposition wholly unwarranted from all the facts known with regard to the affinities of these two elements for one another; the formula of sal-ammoniac must be $NH_3.HCl$. From this salt two sets of metallic compounds are derived; in the one set the metal can be detected by the ordinary tests, in the other this cannot be done; the former may be typified by the formula $NH_3.mCl$,* the latter by $NH_2m.HCl$. An example of the first set is the copper compound, $NH_3.cuCl$, from whose solutions the metal is precipitated as sulphide by hydric sulphide, and, with liberation of ammonia, as oxide by an alkali hydrate. An illustration of the second kind of metallic derivatives of sal-ammoniac is the platinum compound $NH_2pt.HCl$; in the solutions of this combination the platinum cannot be recognised by hydric sulphide, or alkali hydrate.

Dr. Odling then continued by drawing his comparison between the manifestations of the atomicity of nitrogen and those of the atomicity of carbon, showing that, like the tetradicity of carbon, is manifested not only in marsh gas and in methyl-chloride, but equally in ethyl-chloride, propyl-chloride, &c., so the pentadicity of nitrogen is not only manifested in sal-ammoniac, but equally in diammonio-argentic chloride, triammonio-cupric chloride, &c. The lecturer,

* The small letter here, and in the following formulæ, indicates that quantity of a metal which fills the place of one atom of hydrogen.

closed his prefatory observations by declaring his belief in the necessity of studying mineral chemistry in the light of organic chemistry, in order better to understand the reactions and processes of the former. He then gave a short history of the platinum-ammonia compounds, beginning with the so-called green salt discovered by Magnus in 1828, mentioning the salts prepared and described by Gros, Reiset, Peyronne, and others, and finally stating Laurent and Gerhardt's arrangements to classify these compounds. This classification is by no means satisfactory, and having pointed out some of its shortcomings, Dr. Odling concluded his lecture by promising to bring forward at some future meeting his own views on this subject.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor TYNDALL, LL.D., F.R.S. (Lecture IV.)

Historic Jottings, concerning Conduction and the Leyden-jar.

119. In 1727, Stephen Grey, pensioner of the Charter House, discovered electric conduction. Connecting an end of a wire 700 feet long with a glass tube and supporting the wire on loops of silk, he found that on rubbing the tube the distant end of his wire became electrified and attracted light bodies. He also found that a wire loop did not answer as a support, as the electricity escaped through it; hence arose the division of bodies into conductors and insulators. Grey's observations were written down by the Secretary of the Royal Society the day before his death.

120. In October, 1745, Von Kleist, a bishop of Cammin, in Pomerania, charged with electricity a flask containing sometimes mercury, sometimes alcohol. Through a cork in the neck of the flask passed an iron nail, which was brought into contact with the conductor of an electrical machine. On touching the nail Von Kleist experienced a violent shock.

121. In January, 1746, Cunæus of Leyden received also a shock. and his experiment was repeated by Allamand and Musschenbroek. A wire passed from the conductor of the machine into a flask filled with water. Musschenbroek held the flask in the right hand, the machine was turned, and then with the left hand he drew a spark from the conductor. The shock received was, according to Musschenbroek, so terrible, that he declared he would not receive a second for the crown of France. Musschenbroek observed that it was only the person who held the flask in his hand that felt the shock. Kleist failed to recognise this condition.

122. In Germany the jar is sometimes called Kleist's jar, but more commonly, because of the failure just referred to, the Leyden-jar. The theory of it, and other similar apparatus, was given by Franklin in September, 1747. (See Notes 81, 88, 89, 90.)

123. In 1747, Dr. Watson, Bishop of Llandaff, sent the discharge from a Leyden-jar through 2800 feet of wire, and through the same distance of earth. Subsequently, in the same year, he sent the discharge through 10,600 feet of wire, supported by insulators of baked wood. The experiment was made on Shooter's Hill.

124. In 1748 similar experiments were made by Franklin across the Schuylkill, and by De Luc across the Lake of Geneva.

Historic Jottings, concerning the Electric Telegraph.

125. The first proposal of an electric telegraph was made by an anonymous contributor to the *Scot's Magazine* for 1753. Various attempts to apply frictional electricity for this purpose were subsequently made. They culminated in the exceedingly ingenious arrangement of Mr., now Sir Francis, Ronalds, published in 1823.

126. The voltaic pile was described by Volta in a letter to Sir Joseph Banks, written from Como in 1800.

127. Immediately afterwards Nicholson and Carlisle discovered the decomposition of water by the voltaic current.

128. In 1808 Sömmering proposed a system of telegraphy based on the discovery of Nicholson and Carlisle. A similar system was proposed about the same time by Prof. Coxe, of Pennsylvania.

129. In 1820 Œrsted discovered the deflection of a magnetic needle by an electric current.*

130. The idea of employing the deflection of the needle for telegraphic purposes occurred to the celebrated French mathematician, La Place; the problem was partly worked out by Ampére, and still further advanced by Ritchie, Professor of Natural Philosophy in the Royal Institution.

131. In 1832 Baron Schilling constructed models of a telegraphic apparatus, which were exhibited before the Emperors Alexander and Nicholas.

132. In 1833 Gauss and Weber established an electric telegraph between the Physical Cabinet and the Astronomical and Magnetic Observatories of Göttingen, embracing a distance of nearly 10,000 feet. Faraday's electricity instead of Volta's was employed by Gauss and Weber.

133. Steinheil was requested by Gauss to pursue the subject. To the telegraph he made many highly important contributions and suggestions. In 1837 he had established a system of wires about 40,000 feet in length, connecting various points in the city of Munich and its neighbourhood. The most considerable discovery of Steinheil, and indeed one of the most practically important hitherto made in connection with telegraphy, is that the "return wire" between two stations might be dispensed with, and the earth employed in its stead,

134. In 1834 Wheatstone, by means of a rotating mirror, made his celebrated experiments on the velocity of electricity. In the following year he exhibited one of Baron Schilling's telegraphs in his lectures at King's College.

135. In 1836 Mr. William Fothergill Cooke saw in the lectures of Professor Muncke, at Heidelberg, the performance of a similar instrument. Struck by its obvious practical importance, he devised a system of telegraphy, and, in partnership with Wheatstone, dating from June, 1837, succeeded in introducing the telegraphic system into England.

136. From 1832 to 1836 Morse sought to apply chemical decomposition by the electric current to telegraphic purposes; he abandoned this for his electro-magnetic system devised in 1836. This method consists in stamping, by means of the attraction of an electro-magnet, dots and lines upon a slip of paper caused to move by proper mechanism over the circumference of a wheel.

137. In 1850 the first submarine cable was laid by Mr. Brett between Dover and Calais. It survived only a day. In 1851 another cable was laid down, which proved successful.

138. On the 5th of August, 1858, the submergence of the first Atlantic cable was completed, and messages were sent between England and America. The cable ceased to act on the 4th of September, or about a month after its submersion.

* In his exceedingly useful little book on the Telegraph, published in Weale's "Rudimentary Series," Mr. Robert Sabine quotes the following remarkable passage from a work on magnetism, published in Paris, by Professor Izarn, in 1804:—"D'après les observations de Romagnési, physicien de Trente, l'aiguille déjà aimantée, et que l'on soumet ainsi au courant galvanique, éprouve une déclinaison; et d'après celles de J. Majon, savant chémiste de Gènes, les aiguille non-aimentées acquièrent par ce moyen, une sorte de polarité magnétique." The work containing this passage was lent to Mr. Sabine by Mr. Latimer Clark.

139. In 1865 the second Atlantic cable was laid and lost. In 1866 a cable was successfully laid, and in the same year the cable of 1865 was recovered. Messages are now sent between England and America at the rate of fourteen words per minute.

Phenomena observed in Telegraph Cables.

140. Davy showed ("Elements of Chemical Philosophy," 1812, p. 154) that a Leyden-battery could be charged with voltaic electricity.*

141. Dr. Werner Siemens was the first to employ (in 1847) gutta-percha as a means of insulating subterranean telegraph wires. On the 18th of January, 1850, in a paper communicated to the Physical Society of Berlin, he stated that a subterranean wire covered with gutta-percha, and surrounded by the moisture of the earth, behaved like a collossal Leyden-jar. He also found that ordinary telegraph wires charged themselves, though in a much smaller degree than the subterranean wires.

142. In 1838 Faraday predicted the retardation of the electric discharge by its own inductive action. ("Experimental Researches," 1333. "Faraday as a Discoverer," New Edition, p. 89.)

143. In 1854 Faraday experimented with cables at the gutta-percha works of the Electric Telegraph Company. One hundred miles of gutta-percha covered wire were immersed in water, and a second hundred miles of a similar wire were placed in a dry tank, We will call the former the water wire, and the latter the air wire.

144. Connecting one pole of a battery with the earth, and connecting the other pole with one of the two insulated ends of the water wire, on breaking the connection and touching the wire a powerful shock was received; the discharge from the wire was also competent to ignite a Statham fuze. When, after having been in contact with the battery, the wire was separated and connected with a galvanometer, the instrument was powerfully affected.

145. A rush of electricity into the wire was declared by the galvanometer when contact was made; a rush out of the wire was declared when the wire between the battery and the galvanometer was connected with the earth. None of these effects were observed with the 100 miles of air wire.

146. Faraday, like Werner Siemens, rightly explained the effect by likening the cable to an enormous Leyden-jar, the wire constituting the interior, the water the interior coating, with the gutta-percha insulator between them. In fact, the surface of the wire in these experiments amounted to 8300 square feet, while the surface of the outer coating of water was 33,000 square feet. To the charge and discharge of this apparatus the effects observed were due.

147. In a subterranean line of telegraph 1500 miles long were placed three galvanometers: one *a*, at the beginning of the wire: a second, *b*, in the middle; and a third, *c*, at the end, which was also connected with the earth.

148. Connecting the battery with the wire of the galvanometer *a*, that instrument was instantly affected; after a sensible time *b* was affected; and after a still longer time, *c*. It required, in fact, two seconds for the electric stream to reach the last instrument.

149. All the instruments being deflected, when the battery was suddenly cut off at *a*, that instrument instantly fell to zero, *b* fell subsequently, and *c* after a still longer interval.

150. By a brief touch of the battery-pole against *a*, that instrument was deflected, and could be allowed to fall back into its neutral condition before the electric power had reached *b*; *b* in its turn would be affected, and left neutral before the power had reached *c*.

151. In this case a wave of force was sent into the wire which gradually travelled along it, appearing in different parts of the wire at successive intervals of time.

152. It was even possible, by adjusted touches of the battery, to make several successive waves co-exist in the wire.

153. When, after making and breaking contact at *a*, that galvanometer was connected with the earth, part of the electricity sent into the wire returned, and deflected *a* in the reverse direction; here currents flowed in opposite directions out of both extremities of the wire.

154. The effects of induction enabled Werner Siemens and Faraday to explain the widely different velocities assigned by different experimenters to the electric current.

155. To pass through any conductor electricity requires time, the time being directly proportional *to the length* of the conductor.

156. But in the case of a submarine cable, another cause of retardation comes into play, namely. the charging of the cable; the retardation here is proportional *to the square of the length* of the cable.

Artificial Cables.

157. It was to illustrate points like these and to determine the dimensions to be given to the Atlantic cables, that Mr. Cromwell Varley devised his artificial cables.

158. In one of these cables a resistance equal to that of a real cable 14,000 miles in length is obtained by introducing into the path of the current feebly-conducting liquids instead of metallic wires. The inductive action is obtained by means of condensers of tin-foil. In another artificial cables coils of wire are employed to give the necessary resistance.

159. The arrangement described in Note 81 is a condenser. But those constructed by Mr. Varley are of enormously greater area, the condensing sheets being separated from each other not by plates of glass, but by thin sheets of paper and paraffine. The vastness of the

* Davy thus describes the celebrated battery with which he made this experiment. The spirit to which the battery owed its birth has not diminished among the members of the Royal Institution:—"The most powerful combination that exists in which number of alternations is combined with extent of surface, is that constructed by the subscriptions of a few zealous cultivators and patrons of science, in the laboratory of the Royal Institution (in 1808). It consists of two hundred instruments, connected together in regular order, each composed of ten double plates, arranged in cells of porcelain, and containing in each plate thirty-two square inches; so that the whole number of double plates is 2000, and the whole surface 128,000 square inches. This battery, when the cells were filled with 60 parts of water mixed with 1 part of nitric acid, and one part of sulphuric acid, afforded a series of brilliant and impressive effects. When pieces of charcoal about an inch long and one-sixth of an inch in diameter were brought near each other (within the thirtieth or fortieth part of an inch), a bright spark was produced, and more than half the volume of the charcoal became ignited to whiteness, and, by withdrawing the points from each other, a constant discharge took place through the heated air, in a space equal at least to four inches, producing a most brilliant ascending arch of light, broad, and conical in form in the middle. When any substance was introduced into this arch, it instantly became ignited; platina melted as readily in it as wax in the flame of a common candle; quartz, the sapphire, magnesia, lime, all entered into fusion; fragments of diamond, and points of charcoal and plumbago, rapidly disappeared, and seemed to evaporate in it, even when the connection was made in a receiver exhausted by the air-pump; but there was no evidence of their having previously undergone fusion.

"When the communication between the points positively and negatively electrified was made in air rarefied in the receiver of the air-pump, the distance at which the discharge took place increased as the exhaustion was made, and when the atmosphere in the vessel supported only one-fourth of an inch of mercury in the barometrical gauge, the sparks passed through a space of nearly half an inch; and by withdrawing the points from each other the discharge was made through six or seven inches, producing a most beautiful coruscation of purple light, the charcoal became intensely ignited, and some platina wire attached to it, fused with brilliant scintillations, and fell in large globules upon the plate of the pump. All the phenomena of chemical decomposition were produced with intense rapidity by this combination. When the points of charcoal were brought near each other in non-conducting fluids, such as oils, ether, and oxymuriatic compounds, brilliant sparks occurred, and elastic matter was rapidly generated; and such was the intensity of the electricity, that sparks were produced, even in good imperfect conductors, such as the nitric and sulphuric acids.

"When the two conductors from the ends of the combination were connected with a Leyden battery, one with the internal, the other with the external coating, the battery instantly became charged, and on removing the wires, and making the proper connections, either a shock or a spark could be perceived; and the least possible time of contact was sufficient to renew the charge to its full intensity."

area and the proximity of the inducing surfaces combine to exalt the effect.

160. When the condensers themselves are charged by a battery, on discharging them they exhibit phenomena similar to those of a Leyden-jar. The shock, spark, and other effects of frictional electricity are readily obtained.

161. A series of fifty condensers, for example, joined "in cascade," that is to say, with the outer coating of each joined to the inner coating of the next, when charged with a battery of 1000 cells yield powerful sparks, and deflagrate wires.

162. If the wire be bent and introduced into a glass of water, the glass is shattered by the discharge.

163. In the 14,000-mile artificial cable are introduced a series of eleven tubes containing the resisting liquid. Into these dip wires. One end of the charging battery is connected with the earth, and the other end can, at will, be connected with the artificial cable. A series of ten galvanometers are placed between the resisting tubes along the artificial cable.

164. When no condensers are employed, on making connection with the battery, all the galvanometers appear to be simultaneously deflected.

165. When a condenser is introduced between each pair of resisting cells (ten condensers in all), the current has to charge each condenser to a certain degree before it can sensibly affect the galvanometer beyond the condenser. Hence, when the condensers are attached, the action on the galvanometers is successive, not contemporaneous.

166. Mr. Varley supposed his 14,000-mile artificial cable divided into sections representing stations in London, at Gibraltar, Malta, Suez, Aden, Bombay, Calcutta, Rangoon, Singapore, Java, and Australia. Supposing an actual cable laid, and galvanometers placed at these stations, the deflections obtained on establishing battery-contact would be successive; they are represented by the deflections of the galvanometers associated with the artificial cable.

167. By varying the resistance and the amount of inductive condenser-surface, a representation of any other cable may readily be produced.

168. Connected with the needle of each of the ten galvanometers is a reflecting mirror, from which a brilliant spot of light is cast upon a screen. When the cable is not in action, the ten spots form a row along the same vertical line; when the battery-contact is made, the successive deflections of the galvanometers are declared by the successive motion of the spots.

Sketch of Ohm's Theory and Kohlrausch's Verification.

169. I have already spoken (Note 110) of the force which urges forward the electric current (the electromotive force). The amount of this force may be deduced from the action of the current, when opposed by different resistances upon a freely-suspended magnetic needle.

170. If the wire which carries the current be cut across, the current ceases to flow: the electricity ceases to be *dynamic*; but, at the two ends of the severed wire, we have *static* electricity.

171. By suitable instruments, the amount of this statical charge may be determined; it increases with the number of elements of the battery.

172. It is, moreover, proportional to the strength of the current obtained when the wires are re-united.

173. In this way the statical charge becomes a measure of dynamical action: electricity at rest is connected with electricity in motion.

174. In experiments on the electroscopic properties of the voltaic circuit, it is necessary that the battery should be well insulated.

175. If the middle point of a wire which connects the two poles of a voltaic battery be connected with the earth, the tension of that point is null. The circuit gradually rises in tension, right and left, to the two poles of the battery; but on one side of the point we have exclusively positive electricity, while at the other side we have exclusively negative electricity.

176. At equal distances, at opposite sides of the zero-point, the tension is the same.

177. If any other point than the middle be connected at the earth, it becomes the zero-point, right and left of which, as before, we have the two opposite electricities.

178. If the negative end of the battery be connected with the earth, the whole wire shows positive electricity; if the positive end be connected with the earth, the whole wire shows negative electricity.

179. The wire offers a certain resistance to the passage of the current. The battery itself is also in the circuit; and the current has to overcome its resistance also. But the resistance of the battery may be expressed by a certain length of the external wire; when this is done, the sum of the lengths of both wires is called the *reduced length* of the circuit.

180. Given the reduced length of the circuit and the electro-motive force, we can determine, by a simple calculation, the electric tension of every point in the circuit.

181. The circuit through which the current flows may be represented by a horizontal line (called an abscissa); the electric tension at every point of the circuit may be represented by a vertical line (called an ordinate). If ordinates be drawn to represent the electric tensions at a great number of points of the circuit, the line joining the ends of all the perpendiculars will represent the distribution of electric tension in the circuit: the *steepness* of this line also represents what Ohm called the *electric fall*.

182. More strictly, the electric fall is the decrease in the length of the ordinate for the unit of length of the abscissa.

183. The total charge of the wire is expressed by the area of the triangle enclosed by the ordinate, abscissa, and line of fall.

184. The laws of the voltaic circuit, as enunciated by Ohm, have been verified everywhere. The electroscopic state of the circuit has been examined by Kohlrausch, and found to be in strict accordance with Ohm's theory.

185. Ohm assumed the passage of the electric fluid from one section to another of the connecting-wire to be due solely to the difference of electric tension between the two sections. He further assumed the quantity of electricity transmitted to be proportional to this difference of tension; and, from these fundamental assumptions, he deduced the laws of the voltaic circuit.

186. These laws may be briefly stated thus:—

(*a*). The strength of the current is directly proportional to the electro-motive force.

(*b*). The strength of the current is inversely proportional to the resistance.

(*c*). If the wire which unites the two poles of battery be of the same material, and of the same thickness throughout, the "electric fall" is the same throughout the wire.

(*d*). If the wire be of the same material, but of different thicknesses, the "fall" is steeper on the thin wire than on the thick; the "fall," and therefore the strength of the current, is inversely proportional to the cross-section of the wire.

(*e*). If the poles be connected by two wires of the same thickness, but of different resisting powers, the electric fall is steepest on the more resisting wire; the "fall" is directly proportional to the specific resistances of the wires.

187. In verifying these laws, Kohlrausch employed a condenser to augment the feeble charges obtained from his voltaic cell; and he held this instrument to be essential. By an exceedingly skilful device, Sir William Thomson has rendered the condenser necessary, and thus greatly simplified the means of demonstration.

CORRESPONDENCE.

THE METRIC SYSTEM.

To the Editor of the Chemical News.

Sir,—I am glad to see from your abstract of an article from the *Journal für Praktische Chemie*, that a plan for abbreviation of names of the metric system is proposed on something like authority. I should question, however, if the system there proposed will become general, as the use of capitals is inconvenient in writing, and is, so far as I remember, at variance with all our accepted abbreviations, as oz., lb., gr., &c.

My object in writing this letter is not to find fault, but to suggest that some recognised system, either the one referred to or some other, should be adopted in this country. It will not be long, I hope, before the metric system is made compulsory in England, and it is time that symbols for the different terms of the system were established.—I am, &c.,

C. J. Woodward.

Midland Institute,
June 4, 1870.

ELECTRO-COATING IRON WITH COPPER AND BRASS.

To the Editor of the Chemical News.

Sir,—The pithy and able notice of the above subject that you inserted in your report of the last meeting of the Chemical Society, will bear the following remarks from me which were made at the meeting.

The electrolytic brass bath consists of an aqueous solution of equal parts of ammonic tartrate and potassic cyanide. After receiving cyanide of copper and cyanide of zinc in certain proportions, the oxides of the metals are added to the solution. If upon trial, this solution works with the evolution of hydrogen, a little of the blue ammoniuret of copper is added to the cold bath. The heat that may be used to this bath determines the colour of the brass, and may vary from 60° C. to nearly boiling-point.

The cast-iron calico-printing roll that was exhibited was coated with brass in a brass bath, then transferred to an acid copper bath (cupric sulphate) and coated with copper to 3-16ths of an inch thick.

The weight of the roller was 96 lbs., of the copper coating 29 lbs., and of the roller, when finished, 125 lbs.

The other specimens illustrated the deposition of yellow brass and a deep bronze from the same electrolytic bath.—I am, &c.

W. H. Walenn.

74, Brecknock Road, London, N.
June 2, 1870.

TETRABROMIDE OF CARBON.

To the Editor of the Chemical News.

Sir,—In the report of the Chemical Society's proceedings in the Chemical News (vol. xxi., p. 223), the following passage occurs:—

"In the above processes, terbromide of antimony may be substituted for the bromide of iodine."

The passage refers to the preparation of carbon tetrabromide. In the Chemical News (vol. xxi., p. 237), a letter appeared, designating this passage as erroneous; the correspondent expressed himself thus:—

"So far from our proposing the action of *terbromide of antimony* on carbon disulphide as a means of preparing tetrabromide of carbon, I am not aware that these two substances have any action upon one another at the temperature specified, 150° C."

Now, the paper on "Tetrabromide of Carbon," by T. Bolas and C. E. Groves, read by one of the authors at the Chemical Society's meeting on May 5th, contains *inter alia* the following:—

"(*a*). Two parts of carbon bisulphide, 14 parts dry bromine, and 3 parts iodine, were heated together, in a sealed tube, to a temperature of 150° C. for about 48 hours. The contents of, &c.

. . . . . .

"(*b*). Antimony terbromide may be substituted for bromide of iodine in the above process. . . . The above reactions take place, although slowly, at 100° C."

I think there is no further comment required, except, perhaps, to remark that, had the correspondent in vol xxi., p. 237, retained a copy of his scientific paper, he would have spared you much valuable space, and a little time and trouble too.—I am, &c.,

The Reporter.

June 7th, 1870.

MISCELLANEOUS.

Crystalline Alloy of Zinc and Calcium.*—The production of a crystalline alloy of zinc and calcium has been observed in the preparation of calcium by the process of M. Caron, in which an excess of zinc was employed. It contains about 95 per cent of zinc and 5 per cent calcium, corresponding to the formula $Zn_{12}Ca$. These crystals are small octohedrons with square bases. They are acted upon by water, with the liberation of hydrogen. —*Pogg. Annal.*

Illustrating the Gain in Weight of Burning Bodies.*—A very striking mode of demonstrating in the lecture-room that burning bodies increase in weight has been contrived by H. Kolbe. A glass rod is fastened, in a horizontal position, to one arm of a balance. Upon this is fastened a glass cylinder in which a candle is burnt, connected with which, by a glass tube, there is a V-tube for condensing the vapour, a flask filled with lime-water for carbonic anhydride, and two more U-tubes containing soda-lime. The last are connected, by an india-rubber tube, with a Bunsen's pump, by which a steady current of air is drawn through the apparatus. The beam is first counterpoised; as the candle burns away, the arm of the balance to which it is attached sinks down until its progress is arrested by the table.—*Ber. der. Berl. Chem. Gesellsch.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, May 30, 1870.

Omitting the papers and memoirs relating to other branches of science, this number contains the following subject-matter bearing upon chemistry and collateral sciences:—

Physical Phenomena which Accompany the Bursting of Variously-Sized Hollow Projectiles (Bombshells and Grenades) by the Freezing of Water contained therein.—Ch. Mar-

* Communicated by Prof. Morton.

tins and G. Chancel.—The authors first refer at considerable length to the experiments made in this direction by different authors, from the earliest time up to the present day, and discuss the theories broached on this subject; they next relate their own experiments at length, from which they draw the following conclusions:—The bursting of hollow, cast-iron projectiles, by the effect of the freezing of the water contained therein, takes place when from 30 to 40 per cent of the water is converted into solid ice; this quantity of ice causes a pressure which reduces the total bulk by from 1-45th to 1-35th; the pressures required to cause the bursting for shells of 0·22 metre diameter vary from 430 to 590 atmospheres (each at 15 lbs. pressure to the square inch). This paper gave rise to a discussion, the speakers being General Morin, M. Dumas, and M. Elie de Beaumont, who stated substantially that since the properties of the metal are very much impaired by low temperatures, it would lead to erroneous conclusions to calculate, as the authors of the paper think can be done, the powder charges required for the bursting of projectiles; moreover, a very low temperature has been known to render cast-iron, steel, and wrought-iron so brittle, that it can then be readily reduced to powder.

Observations on the Melodious and Harmonic Intervals.—A. Cornu and E. Mercadier.—A paper on acoustics.

Reclamation of the Priority of the Discovery of Cyanic and Cyanuric Ethers.—S. Cloëz.—An abstract from various periodicals published since 1857, here quoted to prove the author's just claims to the honour of having discovered the bodies alluded to.

On Some Compounds Homologous of Tartaric and Malic Acids.—H. Gal and J. Gay-Lussac.—After referring to the labours of MM. Kekulé, Perkin, and Duppa, on this subject, the authors describe adipomalic, adipotartaric, suberomalic, and suberotartaric acids, obtained by a complicated process, described at great length—adipomalic acid, $C_{12}H_{10}O_{10}$; adipotartaric acid, $C_{12}H_{10}O_{12}$; suberomalic acid, $C_{16}H_{14}O_{10}$; suberotartaric acid, $C_{16}H_{14}O_{12}$. The authors exhibit, in a tabulated form, three groups, viz.:—Oxalic, malic, and tartaric groups, each made up of seven different compounds, some of which are, as yet, unknown, and have, therefore, only a hypothetical existence.

Action of Hydrochloric Acid upon Osseine; New Researches on the Estimation of Osseine in Fossil Bones.—A. Scheurer-Kestner.—From the author's researches it appears that osseine is soluble in concentrated hydrochloric acid in the cold, but is not acted upon by very weak acid; in order, therefore, to remove that acid, oxide of silver is employed by the author, and, on evaporating to dryness the neutral liquid thus obtained, a white residue is left, which, on ignition, emits the smell of burning horn, but this substance differs altogether from gelatine in its chemical as well as physical properties. The lengthy memoir contains several matters of interest for the determination of the geological age of fossil bones.

Rapidity of the Absorption of Oxide of Carbon by the Lungs.—N. Gréhant.—The contents of this paper are interesting to chemists, because the author states that, on heating the blood of persons poisoned with oxide of carbon with sulphuric acid to 100°, the gas alluded to is integrally evolved from the blood. The memoir is full of interesting physiological facts, as brought out by experiments.

Direct Preparation of Pyrotartaric Acid.—Dr. J. Sacc.—The author dissolves, by the aid of the heat of a water bath, 100 grms. of pulverised anhydrous tartaric acid in 100 grms of acetic acid; the solution is next placed in a retort and heated over a charcoal fire, until the liquid becomes syrupy; on cooling, this thickish fluid deposits pyrotartaric acid in acicular-shaped crystals.

On Electric Currents; New Observations.—M. Trève.

Phenomena of Electrostatic Induction.—J. Mario.

Theory of Electric Condensers.—M. Neyreneuf.

Description of a Hygrometer Acting by Absorption.—J. Séverin.

The Teacher of Descartes.—A. Georget.—The author, writing from Tours, states that Grandillon was in 1619 a student in a Jesuit college, and did not arrive as Divinity Professor at la Flèche before the year 1626, and that since Descartes had positively before that year left la Flèche, Grandillon cannot have been his teacher there.

Meteorological Observatory at Montsouris.—Sainte Claire-Deville.—The author presents to the meeting a report on this institution, and the labours performed there last year and during the early part of this year. The report contains a detailed description of the instruments employed.

Journal de Pharmacie et de Chimie, May, 1870.

This number contains the following original memoirs and papers:—

Thermo-Chemical Researches on the Bodies formed by Double Decomposition.—MM. Berthelot and Longuinine.—This very lengthy essay is sub-divided as follows—Method of experimenting; acetic chloride, $C_4H_3ClO_2$; acetic bromide, $C_4H_3BrO_2$; acetic iodide, $C_4H_3IO_2$; butyric bromide, $C_8H_7BrO_2$; acetic anhydride, $(C_4H_3O_2)_2$. This essay is to be continued.

Some Experiments with Salts of Chromium.—A. Commaille.—It is to be regretted that this interesting paper is too lengthy for full translation, and is so written that it does not admit of any useful abstraction. It contains the following chapters:—Nitric acid and bichromate of potassa; sulphuric acid and bichromate of potassa; hydrochloric acid and bichromate of potassa; iodic acid and bichromate of potassa; oxalic acid and bichromate of potassa; acetic, tartaric, citric, tannic, and benzoic acids, and bichromate of potassa.

Physical Method for the Determination of those Molecular Groups which are Decomposed by the Electric Current; Application to the Detection of Hydrates Dissolved in Water.—E. Bourgoin.—This essay is divided into the following sections:—sulphuric acid; nitric acid; caustic potassa; sulphate of potassa; sulphate of soda.

Presence of Manganese in Milk and in Blood.—E. Pollacci.—The presence of manganese, as an essential constituent of milk and blood (human, as well as animal), has been known for about 20 years past, but the author gives in this paper some particulars about the method of detection of this metal in the two animal fluids referred to, of which milk contains this metal in the largest proportion; the milk is first evaporated (300 grms. are taken) to the consistency of a paste; this is carbonised by heat in a platinum crucible; the charcoal thus obtained is pulverised, and next completely incinerated; the ash is triturated in an agate mortar and lixiviated with water, in order to eliminate the salts soluble therein, especially chlorides; the residue is treated with very pure nitric acid, and the solution thus obtained is evaporated to dryness and calcined in a test tube; after cooling, a few drops of nitric acid are added, and the contents of the tube again boiled; next, a few grains of puce-coloured oxide of lead are added, and the liquid again boiled; a more or less deeply purplish coloured liquid appears on leaving the tube at rest for a short time, which is due to the formation of permanganic acid. No quantitative researches have, as yet, been made by the author.

Studies on Grapes; their Products and Vinification.—J. Le Canu.

Experiments on the Application of Tin-Foil for the Preservation of Perishable Substances.—E. Baudrimont.—This lengthy paper contains the record of a series of interesting experiments from which the author concludes that tin-foil, in consequence of its impermeability for water, may serve with great effect to protect various substances from the effects of the atmospheric moisture, as well as acting as a protective against the alterations fruit undergoes by evaporation of the fluids therein contained; tin-foil also protects against the oxidising action of the oxygen of the atmosphere, and may hence serve to keep fatty substances from becoming rancid; while, as proved by an experiment of the author, it may usefully serve in laboratories to wrap up caustic lime (quick-lime), bisulphate of soda, and similar substances, which may thus be preserved for a great length of time without deterioration.

Metallic Iron obtained by the Electric Current.—C. Collas.—The author employs a weak solution of chloride of iron, which is decomposed by the aid of a Bunsen battery; perfectly pure iron is thus obtained, which is very friable, highly oxidisable, especially when moisture is present; when this iron, in the state of fine powder, is poured in a bottle, when the atmosphere is very moist, the iron is instantaneously oxidised, water decomposed, and the evolution of hydrogen causes the bursting of the bottle.

Annales de Chimie et de Physique, April, 1870.

This number contains the following original papers and memoirs:—

Experimental and Theoretical Researches on the Equilibrium Figures of a Liquid Mass considered as having no Weight.—J. Plateau.—The 9th to 12th series of this lengthy memoir.

Researches on the Different Varieties of Carbon.—M. Berthelot.—This very extensive memoir is divided into the following sections:—General introduction; description of method for the immediate analysis of the divers varieties of carbon; researches on graphitic oxides; conversion of the same into ordinary organic compounds; investigation of the present state (*état actuel*) of carbon; relation existing between the graphitic compounds and organic substances properly so called; influence of various reagents upon carbon.

Oxidation of the Hydrocarbons.—M. Berthelot.—The main gist of this paper is that the author has found that several hydrocarbons can be directly oxidised without loss of any carbon, and form neutral substances such as aldehydes; this oxidation is effected by chromic acid, dissolved in a small quantity of water; pure ethylen is slowly acted upon, aldehyde being formed—$C_4H_4+O_2=C_4H_4O_2$; this reaction requires a temperature of 120°; propylen is oxidised at the ordinary temperature—$C_6H_6+O_2=C_6H_6O_2$; acetylen is also acted upon at the ordinary temperature—$C_4H_2+O_4+H_2O_2=C_4H_4O_4$.

Synthesis of Phenol.—M. Berthelot.—The contents of this paper have been already quoted from another periodical.

Action of Potassa on the Sulphuric Derivatives of the Hydrocarbons.—M. Berthelot.—The reactions which hydrate of potassa effects with the sulphuric derivatives of the hydrocarbons, no matter which, may be expressed by the following schematical formula:—Being given an acid,

$$C_{2m}H_{2p}(S_2O_6)_n,$$

basic; that acid, treated with potassa, forms a carbide—

$$C_{2m}H_{2p-2n}.$$

$$C_{2m}H_{2p}(S_2O_6)_n + 2_nKHO = C_{2m}H_{2p-2n} + nH_2O_2 + nS_2K_2O_6.$$

Synthesis of Acetic Acid by Means of Acetylen.—M. Berthelot.—The author heats protochloride of acetylen with solution of caustic

potassa in alcohol to 100°, for 10 hours, and thus obtains a large quantity of acetic acid—

$$C_4H_8Cl_2+3KHO_2=C_4H_3KO_4+2KCl+H_2O_2;$$

that is to say, $C_4H_8Cl_2+2H_2O_2-2HCl=C_4H_6O_4.H_2O_2=C_4H_6O_6$; perchloride of acetylen yields, under similar conditions, glycolic acid—

$$C_4H_2Cl_4+5KHO_2=C_4H_3KO_6+4KCl+2H_2O_2;$$

that is to say, $C_4H_2Cl_4+3H_2O_2-4HCl=C_4H_3O_4.H_2O_2=C_4H_4O_6$; treated with aqueous solution of potassa this substance yields oxalic acid—$C_4H_2O_8$.

Polytechnisches Journal von Dingler, first number for April, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

On Naphthylamine Violet.—Dr. A. Kielmeyer.—From this lengthy paper we learn that the author has investigated this subject thoroughly, and his chief result is that pure naphthylamine yields a fast violet on cotton, if applied in the following manner:—Take starch, 456 grms.; water, 1·1 litre; dry naphthylamine, 118 grms.; water, 1·5 litre; pure hydrochloric acid, sp. gr., 1·1279 grms. Boil this mixture, and add, after cooling—chlorate of potassa, 13·5 grms.; water, 0·3 litre; this compound is printed on, and, after printing, first treated (*aged*) as is done for aniline black, and next passed through a solution of soda, in order to eliminate the hydrochloric acid set free after that operation and thorough washing, a pure, fast, brilliant violet is obtained.

Detection of Madder Colours upon Cloth, and by Themselves.—Dr. W. Stein.—The author boils the cloth with a concentrated solution of sulphate of alumina, whereby a liquid is obtained of reddish colour, exhibiting a golden-greenish fluorescence, due, the author says, to the presence of purpurine; the behaviour of the colouring matters of madder towards sulphate of alumina is, says the author, so characteristic, that that salt may serve as an effective test for these substances; the alizarine may be readily rendered soluble by treating the dye material or dyed cloths with alcohol acidified with hydrochloric acid.

Extraction of Beet-Root Juice, and its Defecation and Clearing by Means of Sulphuric Acid, Sulphite of Lime, Lime, and Alcohol, as Experimentally carried on at the Beet-Root Sugar Works at Marly, near Valenciennes, France.—MM. Duquesne and Gil.

On Dualine, a New Kind of Blasting Powder.—C. Dittmar.—Dualine is a mixture of cellulose, nitro-cellulose, nitro-starch, nitro-mannite, and nitroglycerine, in various proportions; it is from four to ten times stronger than ordinary powder.

Aniline Black for Linen.—Dr. Dingler.—The linen fabric is well shaken in a bath containing a solution of acetate of aniline at 4° Baumé (sp. gr. 1·029); this bath should contain besides—sal-ammoniac, 4 per cent; chlorate of potassa, 4 per cent; nitric acid, ½ per cent; sulphate of copper, 1 per cent. After the textile fabric has been aged for about three days, it is first passed through a liquid bath, containing ammonia, at 60°, and next washed in a weak soap solution. A very beautiful black is produced.

First May number, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Electrical Clock.—Dr. Arzberger.—With several illustrations.

Metallic Thermometer.—C. Oechsle.—With woodcuts.

Manufacture of Cast-Steel from Pig-Iron, by What is Termed Inter-Molecular Combustion.—S. Jordan.

Graduation of Oil Testers (Areometers).—Dr. G. Th. Gerlach.

Detection of, and on the Injurious Action of, the Vapours of Acetic Acid Mixed with the Air in Some Manufacturing Processes.—Dr. P. Bolley.—By means of apparatus (not specified), the author found that a cubic metre of air in a calico printing-room, where the ventilation was good, amounted to 7 decigrammes, while, with bad ventilation, as much as 15 decigrammes per cubic metre were detected. The author enters at length into details on the injurious effect of these vapours upon the workmen.

Manufacture of Naphthylamine.—M. Ballo.—The author treats nitro-naphthaline with iron and acetic acid, and distils by means of steam; from the distillate the base deposits, on cooling, in cyrstals.

Revivification of Animal Charcoal by Means of Brüdenwasser.—Dr. O. Tech.—By Brüdenwasser is understood the water occurring near Svojsic, in Bohemia; this water contains from 0·013 to 0·026, and sometimes even 0·5 per cent of ammonia.

Annalen der Chemie und Pharmacie, April 1870.

This number contains the following original memoirs and papers:—

Researches on the Salicin Derivatives.—H. Schiff.—This very lengthy essay contains the following subdivisions—Artificial formation of populine; acetosalicine; preparation of helicine, helicoïdine, and nitrosalicylic acid; acetyl and benzoyl-helicine; acetohelicoïdine; anilide and toluide of salicylglycoside.

Sulpho-urea from Persulphocyanic Acid.—L. Glutz.

Persulphocyanic Acid Aniline.—L. Glutz.

Pseudosulphocyanogen.—L. Glutz.

On Some of the Sulpho-Acids of Benzyl.—Dr. O. Böhler.—This lengthy paper contains the following sections:—Benzylsulpho acid; nitrobenzylsulpho acid; monochlorobenzylsulpho acid.

On a Compound of Essential Oil of Mustard with Bisulphate of Potassa.—Dr. O. Böhler.—After briefly stating that essential oil of mustard—

$$C{=}S$$
$$\|$$
$$N-C_8H_5,$$

combines directly with several substances, as, for instance, ammonia, sulphide of potassium, and organic bases, the author states that he discovered the compound alluded to—

$$C_4H_5NS+HKSO_3=C_4H_6NKS_2O_3.$$

Percentically:—Carbon, 22·01; nitrogen, 6·42; sulphur, 29·55; hydrogen, 2·30; potassium, 17·18; oxygen, 21·91.

Phenylsulphopropionic Acid, a Derivative from Cinnamic Acid.—C. Varlet.

On Some Compounds of Benzol-Aldehyde, and Primary Monamides.—Dr. E. Roth.

Chlorcumarine.—Dr. H. Bäsecke.

Mercurodiphenyl.—E. Dreher and R. Otto.—Mercurodiphenyl is a crystalline material, readily soluble in chloroform, benzol, sulphide of carbon; difficultly so in ether and alcohol; fuses at 120°; sublimes without decomposition; formula—$C_{12}H_{10}Hg$. The authors treat also of the action of hydrochloric, hydriodic, and sulphuric acids, on this material; its behaviour at higher temperature; action of sulphur upon mercurodiphenyl; action of bromine upon mercurodiphenyl; action of chlorine upon this substance; formation of mercuromonophenylchloride from mercuric chloride and mercurodiphenyl; action of hypochlorous acid upon mercurodiphenyl; behaviour of

$$\left.\begin{matrix}C_6H_5\\Id\end{matrix}\right\rangle Hg,$$

and nascent hydrogen; acetomercuromonophenyl,

$$\left.\begin{matrix}C_6H_5\\C_2H_3O-O\end{matrix}\right\rangle Hg;$$

formic and propionic mercuromonophenyl; behaviour of acetomercurophenyl with hydrochloric and sulphuric acids; behaviour of acetomercuromonophenyl towards nascent hydrogen; action of hydrosulphide of ammonium and sulphuretted hydrogen upon acetomercuromonophenyl; behaviour of the last-named body at a high temperature; experiments for the purpose of preparing nitrated mercurodiphenyl; preparation of oxymercurodiphenyl; preparation of phenyl ether by the action of Cl_2O upon mercurodiphenyl; action of bromethylen upon mercurodiphenyl; preparation of zinc-diphenyl; copper and iron diphenyl from mercurodiphenyl.

Direct Conversion of the Fermentation Butyl-Iodide into Trimethyl Carbinol and its Acetic Ether.—E. Linnemann.

Notice Concerning the Derivation of the Law of Avogadro.—K. Zöppritz.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, March, 1870 (No. 207).

This number does not contain any papers or memoirs relating to chemistry or collateral sciences.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 25, 1870.

This number contains:—

Shape of Comets.—Dr. Faye.—A lengthy lecture read on this subject at the Sorbonne, and published with a series of diagrams and cuts.

Asphyxia Produced by the Fumes of Charcoal.—Dr. C. Bernard.—The instalment of this lengthy lecture on this subject, here published, contains the full and exhaustive description of the chemical and histological alterations the blood globules undergo by the action upon them of carbonic oxide and carbonic acid, and the result arrived at by the eminent author is that the asphyxia alluded to is purely due to physico-chemical alterations of the globules aforesaid.

Moniteur Scientifique, No. 322, May 15, 1870.

This number contains:—

The Increasing Expense of Living.—G. Ville.—The continuation and end of this lengthy paper, for which see CHEMICAL NEWS, vol. xxi. p. 215.

Although not exactly belonging to the subjects treated of by us, we quote the title of:—

Use of Contre-Vapeur (Steam Backing) in Locomotive Engines Attached to Trains.—A. N.—A very useful and well written paper on this important subject.

Among the *brevets d'invention* we notice:—

Manufacture on the Large Scale of Nitrate of Ammonia by the Action of Electricity upon a Mixture of Air and Steam.—F. A. A. Dufournel.—The eminent editor of this periodical points out very properly, that what is possible as a laboratory experiment will not pay to do on the large scale.

Tinning of Iron Without the Aid of Heat.—J. B. A. Daubié.—The chief point of interest in this matter is, that the tinning of iron in the cold cannot succeed at all, unless the bath used for that purpose contains, in solution or suspended, an organic substance like starch or glucose, although no precise scientific explanation of this indispensable condition has been hitherto given; the *breveté* employs the following bath—To 100 litres of water are added 3 kilos. of rye meal; this mixture is boiled for half an hour, and next filtered through cloth; to the clear but thickish liquid are added 106 kilos. of pyrophosphate of soda, 17 kilos. of protochloride of tin in crystals (so called tin-salt), 67 kilos. of neutral protochloride of tin, 100 to 120 grms. of sulphuric acid; this liquid is placed in well made wooden troughs, and serves more especially for the tinning of iron and steel wire (previously polished) for the use of carding machines. When instead of the two salts of tin just named cyanide of silver and cyanide of potassium are taken, the iron is perfectly silvered.

New and Improved System for the Manufacture of Fuming Sulphuric Acid.—H. Schemfil.—While the fuming sulphuric acid made at Nordhausen, in Saxony, from previously desiccated sulphate of protoxide of iron, is sold there at from 8 to 12 francs the 100 kilos., that acid as manufactured in France, from an anhydrous bisulphate of soda or potassa, costs from 100 to 140 francs per 100 kilos. The author's plan is to convert iron pyrites, by an expeditious and cheap process, into dehydrated sulphate of iron, and to obtain from this fuming sulphuric acid by a continuous process, the particulars of which cannot be detailed without reproduction of the engravings of the kilns and furnaces devised by the *breveté*, and which are of a very peculiar make.

Les Mondes, May 19, 1870.

Climate of the Haute Savoie.—Rev. Vaullet.—The author, residing at Annecy, states that he can prove that the mean temperature of the Departément of France just named, has perceptibly and steadily increased within the last forty years from 8° to about 10½°; as proof of this statement, he points out that the cultivation of wheat and vineyards is now possible and successful in localities where it was not so forty years ago. Among the causes the author enumerates the cutting down of forests, draining of marsh lands, improvement of roads, and the bringing under tillage of moor and waste lands.

Effects of the Colouration of the Water of the Mediterranean.—J. Girard.—According to the author, who has made several journeys on this large inland sea, its peculiar colour, ranging from pale blue, through all shades of that colour to black (viz., when seen from a ship's deck), is entirely due to the mode of reflection of the sun's rays, according to the lower or higher position of that luminary above the horizon, so that at mornings and evenings, when the rays fall more obliquely, and pass therefore through a larger bulk of water, the colour is deepest, viz., at such distances from the shore where the depth of the sea is sufficiently great.

Discovery of Phosphate of Lime near Charlestown, U.S.—According to the contents of a letter received by the editor of this periodical, there has been recently discovered a layer of a very pure phosphorite, averaging in thickness from 0·40 to 0·60 metre, over a surface of some 250 hectares; this mineral is used as manure by itself, after having been simply ground up to a fine powder.

Annales du Génie Civil, May, 1870.

This number contains a very lengthy paper on—

Soap and Soap Making.—L. Droux.—This paper is far too lengthy for any useful abstraction; it contains copious results of analyses of all kinds of soaps, and also full details on its adulterations.

Annales des Mines, No. 2, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Extraction of Lead from its Ores, by means of a Reverberatory Furnace, as carried on at the Works of the Nouvelle Montagne Company, at Engis (Belgium).—V. Bouhy.

Mineral Resources of the Ariège.—M. Mussy.—Second paper on this subject.

Mechanical Properties of Steel which contains Phosphorus.—L. Grüner.—When phosphorus is present in quantities of from 0·002 to 0·003, it renders steel more elastic and rigid, increases its resistance to breaking force, without modifying its hardness; but such a steel, even if it contains only little carbon, is wanting in body, and is cold-short.

Archives des Sciences Physiques et Naturelles, Suisses, May 15, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Determination of the Coefficient of Expansion of a Bar of Silver.—E. Plantamour and A. Hirsch.

Description of a New Method for Estimating the Calorific Capacity of Fluids.—E. Wartmann.

Remarks on a Memoir on the Specific Gravity of Ozone, published by M. O. Wolffenstein.—J. L. Soret.

Cosmos, June 4, 1870.

General Assembly of the Association Polytechnique.—This meeting was held on the 29th of May last, under the presidency of M. J. Dumas, Sénateur, &c. This Association has been established for the purpose of giving to the working classes the opportunity of becoming acquainted with physical and other sciences, by means of lectures methodically given, to the number of 200 weekly per annum. Some 20,000 workmen attended last year; and the eminent chairman was authorised by the French Government to communicate to the meeting that this Association is recognised as an establishment of public utility.

Serious Illness of Professor Liebig.—V. Meunier.—From a short notice taken from a daily paper, it appears that the celebrated *savant* just named has been seriously ill for some time, having had to undergo twice a dangerous operation on an abscess at the neck. The patient is very feeble, and is stated to have said that he does not believe he will ever recover.

Decrease of the Rainfall in France.—S. Meunier.—The author states that it appears more and more certain that the annual quantity of rain is rapidly decreasing; the cause is attributed to the cutting down of forests, and to the fact that no sufficient care is taken to keep the mountains well covered with suitable vegetation, so as to enable their soil to grow trees in abundance.

NOTES AND QUERIES.

Tungsten Blue.—A sample made by the process given in vol. xxi., p. 130, of our journal, has been sent to our office for T. W. S. If he will forward his address we will send it by post.

Bauxite.—Can any of your readers inform me where I can purchase the bauxite referred to in vol. iii., p. 203, of "Kerl's Metallurgy." It is composed of 13 to 17 per cent of silica, 60 to 65 per cent of alumina, 4 to 8 per cent of peroxide of iron, and 15 to 17 per cent of water in combination.—J. B. S.

Self-Raising Flour.—(Reply to "B.Sc.").—We cannot say for certain, not having had any opportunity of investigating this subject, but it is possible that a small quantity of either dried yeast or, perhaps, good malt powder, is mixed with the material you allude to; both would have the effect of making the flour self-raising upon its being mixed with water.

Phosphate of Ammonia.—(Reply to "J. W. M.")—You cannot make this salt direct from bone ash; you will have to extract the phosphoric acid from that substance, and then combine it with ammonia.

Oxygenated Water.—(Reply to "J. C.")—The process is patented; you can learn at the Patent Office the particulars you desire, and also whether the patent has expired.

Chrome-Colour.—The periodical referred to may be inspected at the Library of the Commissioners of Patents, where you will also find vol. xxi. of *Poggendorff's Annalen*, where, at p. 580, is to be found a full description of Liebig's and Wöhler's process for the preparation of a vermillion-red chrome-colour, for which we also refer you to Gentele's "Lehrbuch der Farben Fabrikation," to be found in the same library.

MEETINGS FOR THE WEEK.

Monday, June 13th.—London Institution, 4.
—— Geographical, 8.30.
Tuesday, 14th.—Photographic, 8.
Wednesday, 15th.—Meteorological, 7. Anniversary.
Thursday, 16th.—Royal, 8.30.
—— Zoological, 4.
—— Chemical, 8.

TO CORRESPONDENTS.

A Young Subscriber.—1. Chloride of nitrogen or a similar chloride. 2. Your explanation is probably correct.

J. C. Major.—Apply to Asher and Co., Bedford Street, Covent Garden. We do not know the price for single numbers.

John E. Williamson, in asking a question, desires us to send the reply to his address, as he does not see the Chemical News. Surely we are not expected to supply information to those whose interest in chemistry is not sufficient to purchase a copy of our journal. If our opinion is worth anything, it is surely worth fourpence! At all events our time is too valuable to write private letters to such correspondents.

C. J. W.—Reinsch's test is the most practically useful for your purpose.

J. Cox.—There are several large works in German, but amongst the smaller works one of the most perfect and comprehensive is Wöhler's "Lehrbuch der Anorganischen und Organischen Chemie," 2 vols., 8vo., published at Berlin by Dünkler.

R. W. W.—We know of no one we can recommend.

Dr. R. Gerstl, C. H. Wood, and *John Pattinson*, are thanked for their communications.

THE CHEMICAL NEWS.

VOL. XXI. No. 551.

ON THE DESCENT OF GLACIERS.*

By The Rev. HENRY MOSELEY, M.A., F.R.S.,
Canon of Bristol, and Instit. Imp. Sci. Paris Corresp.

GLACIERS do dot take their origin in the highest Alpine regions. It is not there that the snow chiefly falls, but on a belt girding them below. This wide belt is divided horizontally into an upper and lower part by the snow-line, at a height of from 3000 to 3300 yards. Above that line snow always lies, and rain very rarely falls; beneath the snow-line the snow disappears every summer, and rains are abundant. It is from this belt about the snow-line that the glaciers are seen emerging. They lie like huge slugs along the descending valleys, swelling themselves out to fill their channels where they are wide, and thinning themselves to pass through the gorges and narrow places in them. They seldom come down to a lower level than 1100 yards. Between this level where they end and the snow-line, 3100 yards high, where they begin, they traverse sometimes a very long space—lying for the most part at a low pitch. The resemblance to a huge mollusk is kept up in *this*, that they move with a strange slow motion, not altogether unlike that of such an animal. The parallel will be complete if we conceive the mollusk to have its tail continually renewed as it withdraws it from under the snow-line, and its head continually melted away as it thrusts it forward below the level of from 1000 to 1400 yards. If we further imagine the steep sides of the valley through which the glacier descends to have similar but smaller glaciers crawling down them to the principal glacier, we shall understand what is meant by tributary or secondary glaciers, which are *thus* placed in regard to the principal ones; having a far greater pitch or slope than they, and flowing into them like tributary streams to a river. The slope of a principal glacier is often as little as 3°, and yet it may move with a velocity of 24 inches a-day. The slope of a tributary glacier is sometimes 50°, and it may not advance more than 4 or 5 inches a-day at the most.† Masses of rock of different sizes, from huge boulders to stones, are constantly broken by the frost from the sides of the valley of the glacier, and are carried slowly down on its back to the level where its head melts away, and there are deposited. These are called moraines. They lie along the course of the glacier in ridges, protecting the ice beneath them from the sun's rays. That ice does not therefore melt as the rest of the ice does, and so it forms a ridge of ice. A moraine is, therefore, a ridge of stones standing on a ridge of ice.

The descent of a glacier is not a descent of the whole together, or bodily like that of a block of stone. There is an internal descent of every particle in the glacier over and alongside of every other particle. If a plane section be imagined to be made across it, the particles of ice passing through that cross-section at any time must be conceived to be all moving at different rates so as to be sliding over and beside one another; the particles at the surface moving faster than those below, and the particles near the centre moving faster than those at a distance from it, exactly as the particles of a stream of water move.

The existence of this differential motion is strikingly seen in what is called the veined structure of glaciers. This veined structure appears first to have been described by M. Guyot, in the year 1838. The following is his account of it, as he saw it on the glacier of Gries, which I translate from the work of M. Huber:—

"I saw under my feet the entire surface of the glacier covered with furrows an inch or two wide, cut in snowy ice, and separated from one another by ridges of harder and more transparent ice. It was evident that the mass of the glacier was here formed of these two different kinds of ice; the former (that of the furrows) was white and melted more rapidly; the other (that of the ridges) was more perfect, crystallised, transparent, and hard. The unequal resistance to melting of these two kinds of ice was the obvious cause of these depressions and elevations. After having followed them for several hundreds of metres I reached a crevasse 20 or 30 feet wide, which, cutting the furrows at right angles, exhibited down to the depth of 30 or 40 feet an admirable transverse section of this structure. As far as my eye could reach I saw the mass of the glacier composed of layers of the [opaque] white ice separated from one another by layers of the transparent ice, the whole forming a mass as regularly stratified as certain calcareous rocks." This is the veined structure of glaciers.

[Canon Moseley's remarks on the differential motion of glaciers, with special reference to the observations and experiments of Forbes and Tyndall, illustrated by diagrams, will be found in the *Philosophical Magazine* for April, 1870.]

The effect of the differential motion in *separating* and *distributing* the parts of a glacier has been shown in various ways. The remains of the guides lost in 1820 in Dr. Hamel's attempt to ascend Mont Blanc were found imbedded in the ice of the Glacier des Bossons in 1863. "The men and their things were torn to pieces and widely separated, many feet. All around them the ice was covered in every direction for 20 or 30 feet with the hair of one knapsack spread over an area three or four hundred times greater than that of the knapsack. "This, says Mr. Cowell, from whose paper read before the Alpine Club in April, 1864, I have made the quotation, "is not an isolated example of the scattering that takes place in or on a glacier; for I have myself seen on the Glacier of Theodule the remains of the syndic of Val Tournache scattered over a space of several acres."

Whatever the force may be which causes the descent of glaciers, it must be chiefly expended in this constant displacement of the particles of the ice over one another and alongside one another, of which the veined structure affords the evidence, and to which is opposed everywhere that force of resistance which is called *shearing* force. By the property of ice called regelation, when any surface of ice so sheared is brought into contact with another similar surface, it unites with it, so as to form of the two one continuous mass. This may be shown by experiment. If a cylinder of ice be placed in an apparatus suitable for the purpose and slowly sheared partly across, the new surfaces continually being brought in contact with one another in the act of shearing will not present the slightest appearance of separation, the ice being *there* as continuous as elsewhere, its molecules entering into precisely the same relations to one another in their new positions as they did in the positions out of which they have been sheared. Thus a slow displacement of shearing, by which different similar surfaces of ice in a glacier were continually being brought into presence and contact with one another, would exhibit all the phenomena of the motion of glacier ice.

The late Principal Forbes calculated that in the Aar glacier the shearing displacement amounts to 13-14ths of the whole displacement of the glacier. The sliding displacement of the whole glacier bodily on its bed is, in comparison with it, unimportant as it regards the expenditure of force requisite to bring it about. The differential

* Read before the Royal Institution of Great Britain, Friday, May 13, 1870.

† The motion of the Glunberg, a tributary of the Aar glacier, inclined at 30° to 50°, was found by Desor to be 22 metres a-year, while that of the Aar glacier, inclined at 4°, was 77 metres.

motion is the *great* and *characteristic* phenomenon of the descent of glaciers; but it is that, in assigning an adequate cause for which, existing glacier theories seem to me most conspicuously to have failed.

The Swiss philosopher De Saussure was the first to study the descent of glaciers with care, and wrote on it about sixty years ago. He held that glaciers slip down the slopes on which they rest by their weight, just as other bodies slip down inclined planes. This explanation is simple, and was generally accepted as long as it was thought that glaciers slipped down bodily like blocks of stone would, with an equal motion of all their particles; but when the internal motion of their particles upon one another, like that of running water, came to be discovered, and when it was found that the high-pitched tributary glaciers moved slower than the low-pitched principal ones, this theory was brought into doubt, for it was in direct contradition to these facts.

M. Rendu, the Bishop of Annecy, considered the descent of a glacier to be so like that of a fluid that it was impossible to explain it otherwise than by supposing ice actually *to be a fluid* and not the *solid* thing it seems to be. He was the founder of the celebrated viscous theory of the descent of glaciers, advocated with such remarkable energy, industry, and ability by the late Principal James Forbes, whose various works on glaciers have exhausted the whole field of observation and supply most of the facts on which the true solution of the problem, whenever it is arrived at, must be founded. When, however, at another stage of the inquiry, it came to be discovered by Faraday and Tyndall that ice, when broken up, was capable of being united again by sufficient pressure, so as to become as perfectly solid and homogeneous as it was before, it became evident that supposing a sufficient pressure to be exerted on the glacier, in the direction of its descent, to crush its substance through the contractions and gorges of its channel, and over the irregularities in its bed, it would reform itself and solidify, and become a compact mass again as it was before, when it had passed these obstructions. This is the regelation theory.

At this stage the question had assumed this new form—"If ice be a viscous fluid, according to the viscous theory, is it fluid *enough* to descend by its own weight; or, if it be a solid, according to the *regelation* theory, is it *little* enough solid so to descend?"

If, instead of ice, a glacier were of water, it *would* obviously descend by its weight. The same would be true if it were of oil, or soft mud, or quicksilver, or probably of pitch; but if it were of iron, or of copper, or of lead, it would not descend by its weight only, unless, indeed, these metals were in a state of fusion. A quicksilver glacier would descend by its weight only because it shears easily; a cast-iron one would not, because it shears with difficulty. There must, therefore, exist a relation between the shearing force and the weight of a given volume of a glacier, so that it may just descend by its weight only. Now, it is possible to investigate mathematically what that relation is.

I have made that investigation.* I have founded it on this well-known law of mechanical philosophy, that "The aggregate *work* of the forces which produce the displacement of a body or a system of bodies (however related) must, at least, equal the aggregate work of the resistances which oppose that displacement."

The resistances opposed to the displacement of a glacier are—1. Those which oppose themselves to the shearing of one surface of ice over another, which is continually taking place throughout the whole mass by reason of the differential motion. 2. The friction of the superimposed laminæ of ice upon one another, which is greater in the lower than the upper. 3. Abrasion of the ice on the bottom and sides of the channel of the glacier. If it descends by its weight only, then the work of its weight in its descent through any distance must at least equal the sum of the works of all these resistances. It is, of course, impossible to represent this relation mathematically in respect to an actual glacier having a variable direction and an irregular channel and slope; but in respect to an imaginary one having a constant direction and a uniform channel and slope, it is possible. I have made that calculation, and it results from it that the unit of shear in ice (that is, the force necessary to make one square inch of ice shear over another square inch) must not be more than 1¼ lb. that a glacier may descend by its weight only. If the unit of shear in ice be more than that, then the glacier cannot descend by its weight only on a slope like that of the Mer de Glace. But it is a great deal more than that. It requires from 60 lbs. to 120 lbs. to shear one square inch of ice over another square inch. The ice of the Mer de Glace cannot, therefore, descend by its weight only; it does not shear easily enough. It must be ice of about the consistency of soft putty to descend by its weight only, for that substance shears with a pressure of from 1¼lbs. to 3 lbs. per square inch.

Ice, therefore, if it be fluid, is not fluid *enough*, and if it be solid, it is *too* solid to descend by its weight only. There must be some other force to help it down besides its weight—certainly forty-five times greater, and possibly ninety times. The imaginary case, to which alone these calculations apply, differs, indeed, from the actual case of a glacier in this respect, that it is straight and uniform. But if its weight be insufficient to bring a glacier down a straight and uniform channel, much more will it be so to bring it down a crooked and variable one. This result is directly opposed to the viscous theory and to that known as the theory of regelation, both of which attribute the descent of glaciers to their weight as the only cause. It reveals the existence of some other force. What is it?

(To be continued.)

* *Phil. Mag.*, May, 1869.

ANALYSIS OF THE KHETTREE METEORITE, WITH AN ACCOUNT OF ITS FALL.

By D. WALDIE, F.C.S.

THE meteoric stone, of which the analysis is given in the following pages, fell near Khettree, Rajputana; and the sample was supplied to me by Mr. W. Stotesbury, of the Topographical Survey, who at the same time communicated an interesting account of the circumstances of the fall, of which he was to some extent personally cognisant. The account I shall give in his own words, from his letter to me.

"Whilst employed in making a topographical survey of a portion of Shekawattie, in Rajputana, in February, 1867 (I forget the exact date),* I was out at work one morning at about 9 o'clock. I was suddenly startled by a loud report, resembling that of a cannon, at Khettree, the seat of a petty prince, about 11 miles distant to the south of the place where I was then working. The first report was followed by two more, louder than the first, but a little to the east of the place where I imagined I heard the first report; these three were succeeded by a regular roll, resembling musketry heard at a short distance. The day being a beautiful bright one, and no clouds to be seen anywhere, and also seeing no stones falling, I did not know what to make of this (to me) strange atmospheric phenomenon. I immediately communicated the above facts to the Editor of the *Delhi Gazette*, asking to know what these strange reports in the air meant, and the cause thereof. The day after I had posted the letter, I was informed by some villagers that, the day before, they heard the reports, and that a shower of aërolites had fallen, and that the stones had been seen by them. Mr. Robert Todd, a friend of mine, and in the same survey-

* Mr. Stotesbury has since found, from an entry in one of his books, that the date was January 19th, 1867.

party as myself, seeing my query in the *Delhi Gazette* regarding these reports, wrote to the Editor of the above paper, informing him that they were caused by a fall of aërolites: he was at that time working about 10 miles to the east of me, and describes the reports, &c., the same as I have mentioned already. The showers of stones, as I learned afterwards from the villagers, amounted to about forty, which fell chiefly near a village called Saonlod, 3 miles to the north of Khettree, in Shekawattie, Rajputana (lat., 28° 9′ 45″ N.; long., 75° 51′ 20″ E.; and about 90 miles S.-W. of Goorgaon, near Delhi).

"The natives, not knowing what to make of these stones, and being just as superstitious as, if not more than, all natives of India, put it down the vengeance of some offended deity: they therefore set about gathering all the stones that they could find; these they afterwards pounded down to powder, and scattered this to the breeze, &c., so as not to let the vengeance of the offended god redound on them. No sooner did I hear of the fall of the stones, and ascertained the exact locality, than I sent all the Sowars attached to my camp to scour the country round about the place, with the intention of procuring as many of the stones as possible. I was very nearly too late; as, between them all, they only managed to get the piece I sent down to you, and that by a promise of a large reward. I cannot fully describe to you the fear of the inhabitants of the villages adjacent to where the stones fell, and their amusing and queer descriptions as to their ideas of the cause and nature of the aërolites.

"I am sorry I had not an opportunity of viewing one of the stones before they had been broken by the foolish villagers, as I should have then been able to give you the real size, &c., of them; but, from descriptions given me by the more respectable class of natives, I should say the stones were about the size of a 24-pounder shot, quite round, with a blackish appearance on the outside, and impregnated with a sulphurous smell. They fell with such velocity that they sank 2 or 3 feet into the ground, a sandy soil. The men who gave me these descriptions I summoned and questioned them myself. Of course, as is natural with natives, I received all sorts of communications regarding the fall of the stones; but they are only as foolish as they are untruthful, so it is no use my giving them you. The descriptions I have now given you may be relied on, as they are collected, by myself, from personal interviews with the more informed and respectable class of natives, such as Mahajans, Pataels, and the Raj officials; and I only kept those descriptions that tallied with others I had previously received from others."

The stone is partly of a light bluish grey colour, partly of a much darker grey; in some places the two portions lying in contact like two strata, in others nodules of the one imbedded in the other. The broken surface is studded over with metallic particles, many of them having a bright metallic lustre; and there are also observable, by aid of a lens, spots of a yellowish or brown colour, from oxidation of the iron, and granules of a greenish-yellow colour and translucent appearance, probably olivine. Spherules of earthy matter are also visible, and round cavities in which others have been imbedded. When coarsely powdered, the spherules are more visible; and, when more finely powdered and examined under water with the lens, the lighter portion of the stone exhibits a considerable quantity of a nearly white crystalline matter, the particles of which are tolerably uniform in size, mixed with small angular fragments of black, brownish, opaque, and greenish-yellow, translucent minerals, and irregularly-shaped but rounded particles of iron. The dark grey portion exhibits the same appearances, but with a much larger proportion of dark-coloured, earthy minerals. The particles of the iron, having resisted trituration, now appear much larger than the others. After the metallic matter has been removed by acid, the remainder seems to consist of the white, fine, crystalline matter observed in the original light grey portion of the stone, mixed with a few black particles. The stone is not very hard, and, but for the particles of iron, is not difficult to powder.

It is covered with a dark grey, nearly black crust, cellular on the surface, and corrugated somewhat longitudinally, and of about one-third of a millimetre thick.

Many of the older analyses of meteorites are very imperfect, being very defective even in the detection and estimation of the chemical constituents. Of late, the chemical examination has been much more complete, and improvements have been made in their proximate analysis, obviously a matter of the greatest interest. The most recent of these investigations have been the very valuable ones by Daubrée and Meunier, of the Museum of Paris, chiefly on meteoric iron, for the separation of the uncombined metal from the sulphides and phosphides and other constituents. As my attention had not been previously directed towards the analyses of meteorites, I did not notice their papers so early as would have been desirable, and lost time and labour in the first processes employed. The separation of the earthy minerals is still very imperfect, and there are no very obvious means available for this purpose.

The general plan of analysis followed was to act upon the powdered stone first by acid solvents, and afterwards to extract the silica set free from combination by boiling with solution of carbonate of soda. The matter resisting the action of these agents was attacked in the usual way, by fusion with alkaline carbonate, or with baryta. The boiling with carbonate of soda was troublesome: the solution could not be filtered perfectly clear; it always carried with it a small portion of undecomposed mineral in a fine state of division.

The constituents were those generally found in meteoric stones of similar appearance. The part soluble in acids consisted chiefly of silicate of magnesia and iron, with interspersed particles of nickel, iron, and sulphide of iron. The part insoluble in acids was also chiefly silicate of magnesia and iron, but with a much larger proportion of silica.

The analysis of several different portions showed a certain variety of composition. Thus the insoluble matter varied from 39·5 to 42·6 per cent of the whole. In the soluble portion, the total amount of iron varied from 24·7 to 27·7 per cent in all states. As the particles of iron differ very considerably in size, it follows that, as the proportional quantity of these varies, so must that of the other constituents.

But treatment with acids did not show the amount of iron in the free state, as distinguished from that in combination; iodine answered better, but acted partially on the sulphide of iron, as well as on the uncombined metal. Recourse was had to the solvent lately proposed by Meunier—solution of bichloride of mercury, which dissolves the uncombined metal only: the mercurous chloride produced was removed by a current of chlorine, according to his plan, and metallic mercury by heat; the remaining mineral was then treated by hydrochloric acid, preferably with addition of some nitric acid. From the amount of iron found in this acid solution, a proportion was deducted as combined with the sulphur and phosphorus; the remainder was calculated as oxide. The sulphide of iron was taken as Fe_7S_8, troilite, as contended for by Meunier. The whole of the nickel is supposed to be in the state of alloy with iron, though probably part exists as sulphide.

An attempt was made to separate the light-coloured portion of the stone from the dark, so as to compare their composition in the principal points. The light-coloured portion was got free from the dark, but the dark remained still mixed with a considerable portion of the light-coloured. The differences observed will be pointed out after the results of the general analysis have been given.

A little phosphorus was found, and is supposed to exist in combination with iron, 1 equiv. to 3 equivs. iron,—Schreibersite.

The results of analysis are as follows:—

	Dried at 212° F.		
Iron	16·98		91·54
Nickel	1·26		6·79
Cobalt	0·21		1·15
Chromium	0·10		0·52
Nickel iron	——	18·55	100·00
Iron	2·69		51·54
Sulphur	1·76		33·71
Iron	0·65		12·46
Phosphorus	0·12		2·29
Troilite and Schreibersite	——	5·22	100·00
Magnesia	13·76		39·11
Lime	0·68		1·93
Soda	0·09		0·26
Protoxide of iron	7·51		21·35
Alumina	0·41		1·17
Silica	10·73		30·50
Loss (removed by carbonate of soda with the silica)	2·00		5·68
Earthy matter soluble in acids	——	35·18	100·00
Magnesia	10·04		23·70
Lime	1·69		4·00
Soda (with trace of potash)	0·78		1·84
Protoxide of iron	3·65		8·62
Oxide of chromium	0·40		0·95
Alumina	1·36		3·22
Silica	24·44		57·67
Earthy matter insoluble in acids	——	42·36	100·00
		101·31	

The earthy matter insoluble in acid is augitic in character, and closely resembles, in composition, the minerals tremolyte and actynolyte, except that above two-thirds of the lime in those minerals is replaced in this by protoxide of iron. It also contains chrome-iron to the extent of 1·39 per cent, or 0·59 per cent of the entire stone.

The earthy matter soluble in acids is somewhat similar in composition to chrysolite or peridote, but contains a larger proportion of magnesia and iron. There is probably a much greater mixture of different minerals than in the case of the insoluble portion.

There is a little chromium soluble in acid, and also soluble in iodine, at least partially. I have supposed it to be a constituent of the nickel iron alloy.

Several portions which had been treated with acids (in which, consequently, uncombined iron could not be estimated) contained, in the soluble portion, more silica than is given in the above analysis (about 2 per cent more). The proportion of matter insoluble in acid, in these cases, was about 39·5 per cent of the whole stone.

Attention was directed, as already stated, to the differently-coloured portions of the stone. Analysis gave the following results:—

	Light-coloured.	Dark-coloured chiefly.
Specific gravity in small pieces	3·743	3·612
,, again wetted	3·763	3·704
,, in powder	3·818	3·729

Constituents Soluble in Acids.

	Light-coloured.	Dark-coloured chiefly.
Uncombined iron	17·77	16·20
Sulphur	1·75	1·77
Magnesia	13·65	13·88
Protoxide of iron	6·67	7·76
Cobalt	all, or nearly all.	none, or nearly none.

The portion insoluble in acids differed little in the two kinds. It will be observed that the principal difference is in the relative proportion of uncombined and oxidised iron, the dark portion containing most oxide of iron, the light part containing most uncombined iron, and all, or almost all, the cobalt. The higher specific gravity of the light-coloured portion accords with the greater quantity of metallic iron it contains. The state of oxidation of the iron was not experimentally determined, but was assumed to be that of protoxide, in accordance with the analyses given of similar terrestrial minerals. The cause of difference between the loss of weight sustained by boiling the mineral after the action of acids and the weight of the silica obtained appears to depend upon small quantities of other constituents, removed by the carbonate of soda in solution or in very fine states of suspension. In one experiment, made with great care, the difference of weight was nearly accounted for in this way in alumina and oxide of iron, lime, and magnesia. In this case, the loss of weight by carbonate of soda was 12·015 grs.; the silica obtained 11·563 grs., loss only 0·452 gr. Of the above constituents, there was obtained 0·315 gr., leaving only unaccounted for 0·137 gr. from 100 grs. of the stone.

I have compared its composition with that of other stones, as given in Buchner's "Treatise on Meteorites," Leipzig, 1863, and find it bears a pretty close resemblance to that of "Blansko," (Brünner Kreis, Mæhren), November, 1833, and that of "Insel Oesel," in Russia, April, 1855, and a still closer one to that of "Klein-wenden," by Nordhausen, Prussia, of September, 1843.

ON TWO PECULIAR PRODUCTS IN THE NICKEL MANUFACTURE.

By JOSEPH WHARTON.

I.

SEVEN years ago, when I was about to commence operations at Gap Nickel mine and furnace, I noticed among the fragments left by my predecessors a piece of nickel matt which contained occasional plates apparently of a metallic substance, tough, pliable, and elastic,; these plates were about as thick as fine writing paper, from $\frac{1}{16}$ inch to $\frac{1}{4}$ inch wide, and about twice as long. No chemical examination of them was made except a slight qualitative examination showing the presence of nickel, iron, and copper.

Having on several occasions subsequently noticed some tendency to a similar appearance in the matt, I gave directions that, when it should next be observed, a close examination should be made, after the extinction of the furnace producing the peculiar matt, of the solid mass which always remains in the bottom of the furnace.*

This solid mass consists in part of lumps of ore, flux, and fuel of the first charge, which reached the hearth imperfectly melted or consumed and so remained, and in part of accretions from the thoroughly fused matt which, as the furnace worked, formed a pool over and enclosing those lumps.

The cavities of such a mass seemed to me favourable for the production of crystals when a tendency to crystallise existed.

Last midsummer very interesting groups of crystals were, in fact, found upon breaking up one of these masses to fit it for re-melting; they were so small, however, that except for search being made in consequence of the matt of that furnace having exhibited the plates above named, the crystals would probably not have attracted attention.

* It should be explained that the furnaces in question are small upright blast furnaces, in which the ores of Gap Mine (Nickeliferous Pyrrhotite with 2 per cent Ni and Co), previously roasted, are smelted for the first time, the product being a matt containing about 12 per cent Ni and Co, with about 4 per cent Cu.

Some of these crystals are cubical, with a bright metallic lustre, the groups closely resembling miniature geodes of galena; others are minute octahedrons, arranged in spiculæ, and in dendritic or plumy forms, resembling the fern-like aggregations of zinc crystals which I sometimes found in the prolongs of my spelter furnaces at Bethlehem, Pa.

These crystals are very tough, and are highly magnetic. A spicula of the octahedrons can be bent many times without breaking, and one which was floated upon water, after being lifted a few times by a magnet, pointed steadfastly to the north, and showed attraction and repulsion to the poles of a magnet just as a steel magnetic needle would under like circumstances.

A specimen of the octahedral crystals, and a specimen of the granular or almost crystalline solid matter to which they were attached, were submitted for analysis to the chemist of my establishment with the following results:—

	Crystals.		Granular.	
Cu	1·85	0·466	1·74	0·438
Ni and Co ..	25·22	6·837	28·20	7·640
Fe	64·10	36·622	62·50	35·861
S	8·90	43·925	7·60	43·939
	100·07	1 : 4·93	100·04	1 : 5·78

The subordinate column in each case shows the quantity of S which would be requisite to form, with the metals found, the compounds Cu_2S,Ni_2 and Co_2S,FeS; the ratio, below it, is that of the S found to that thus calculated.

If we conceive the copper to exist as Cu_2S, we then have 89·32 parts Fe, Ni, and Co in combination with 8·43 parts S: taking then the average atomic weight of the metals according to the proportions found, as 56·85, the atomic ratio of the metals to that of the sulphur is as 31·4 to 5·27, corresponding very closely to the formula R_6S.

Should the copper be included in the average, we get the figures R 32·00, S 5·56, indicating, though less accurately, the same formula.

II.

Desiring last year to make, in a granulated form, an alloy consisting of ¾ nickel, ¼ copper, I caused a mixture of the oxides of those metals in the due proportions to be heated in closed crucibles with charcoal in a blast furnace; by this means reduction and fusion resulted, and the fused alloy was poured into water at a high white heat.

Among the granulated metal were found large numbers of hollow spheroids varying in size from peas to large chestnuts, many of them imperfect and torn, but many of them tolerably regular in shape, one side being usually bright and smooth, while the other was rough and pimpled.

As, upon crushing these with a hammer, the anvil was moistened, I examined a considerable number of them, and found that they were nearly full of water, so that the water distinctly rattled within them when shaken, and showed itself in quantity when the larger spheroids were carefully broken. Fluid metal, poured white-hot into water, had formed metallic bulbs filled with water.

For several days I carried some of these bulbs in my pocket, occasionally rattling the water in them, before the manner of their formation occurred to me. My first idea—that drops of metal falling upon the water were flattened by the blow, and that the edges then instantly clasped together and became welded, enclosing water within their grasp—was obviously untenable, for the eye could detect no seam or crevice, and besides, how could water exist as a liquid shut in by walls of this refractory alloy at a welding heat? Apple dumplings are formed in a manner somewhat similar to that, but these bulbs were not so formed.

The true solution is doubtless this: The metal when poured was in a state of ebullition, was giving off gas; not probably metallic vapour, but perhaps carbonic oxide.

The separate globules into which the thin stream divided upon entering the water, were each emitting gas when contact with the water produced upon their surfaces an impervious film of solid or pasty metal. The continued evolution of gas in the fluid interior of such globules could have then no other effect than to distend the globule into a bulb, whose upper side might well be pimpled by the effort of tiny gas bubbles in the pasty shell to escape upward, while similar tiny bubbles working upward in the crust of the under side would reach the interior cavity, thus leaving the lower surface smooth and bright.

Multitudes of incipient globules were, of course, torn and distorted by reason of the internal gas finding a vent, and, of course, any which were rent must necessarily be filled by the water in which they were plunged. Those, however, in which the eye found no aperture were doubtless filled, after the coldness of the external water had so contracted the heat-rarefied gas as to produce an approximate vacuum within the bulb, by the slow imbibing of water through minute pores to supply that vacuum. That such pores existed was shown by the fact of the bulbs all, in time, losing their water by exposure to a desiccating atmosphere.

Not all the pots of metal produced, when poured, such globules, for not all were in the fit state of ebullition.

The nature of the disengaged gas might perhaps have been determined, if a sufficient quantity had been collected by breaking the globules under a receiver, but this was not done.—*Am. Journ. Sci.*, xlix., 365.

Philadelphia, March, 1870.

INVESTIGATION OF FLAME-TEMPERATURES, IN THEIR RELATIONS TO COMPOSITION AND LUMINOSITY.*

By Profs. B. SILLIMAN and HENRY WURTZ.

I.

Calorific Powers or Effect of Gases.

These subjects lie, in our belief, at the very basis of the true theory of the phenomena of luminiferous gases, and have practical bearings that can scarcely be overrated.

In fact, our studies of the subject have led us in the direction of the general conclusion that, all other conditions being equal, the *temperature* in a given flame is the main factor of luminosity. This, however, may as yet be regarded merely as an hypothesis, in consequence of the imperfection of our present means of actual experimental demonstration of the temperatures of flames. It is an hypothesis, nevertheless, which is in general accordance with known facts. By the spectroscope, for example, which can recognise only luminous rays, we find that the higher the temperature the greater the number of these luminous rays. The recent results of Frankland upon the development of luminosity by increased pressure, in flames which are non-luminous under atmospheric pressure, are in accordance with this view; increase of temperature necessarily following increase of pressure.

Very vague views have been rife, even among chemists, with regard to the temperatures of luminiferous flames. Some have been satisfied with believing crude hypotheses—such as that the heat-power of a flame is always proportional to the *density* of the gas or vapour undergoing combustion, or that it is proportional to the *amount of oxygen consumed* by a given volume of the gas, and so on. This latter hypothesis has been one of very common acceptation. A view which is even now entertained by some

* Read to the American Association at Salem. Communicated by the Authors.

skilful chemists (than which, however, nothing, as will be shown below, could be more fallacious) is that those individual gaseous compounds which impart the highest luminosity, under ordinary conditions, are also the most productive of heat.

The admirable researches of the great gas-chemist, Bunsen, of Heidelberg, placed in our possession, some years ago, the means of computing, at least with approximate accuracy, the heat of flames of gases of known compositions. Few, however, have properly and successfully applied Bunsen's method in practice. We consider it quite time that these methods should be introduced to the knowledge of gas-engineers, in forms available to them.

Bunsen's *formulæ* for these computations are based upon the actual experimental determinations of the *total* amounts of heat developed by the combustion of different pure combustible gases with pure oxygen made by Favre and Silbermann, and upon Regnault's determinations of the specific heats of gaseous products of combustion.

It is not to be maintained that Favre and Silbermann's numbers are strictly correct, but they are doubtless approximate, and at least proportionately correct among themselves; at any rate, they are the best data we have. Those employed here are included in the following table. They are usually given in the text-books for equal *weights* of the gases; but we have reduced them to the standard of equal *volumes* also, as more suitable to our present purpose. This reduction is made simply by multiplying the equivalents for weights by the densities as given in the third column.

TABLE I.

	Total caloric equivalents		
	Of equal weights.	Of equal volume.	Densities on scale of hydrogen = 1.
Carbonic oxide	34,462° C.	34,462° C.	1·0
Hydrogen	2,403° ,,	33,642° ,,	14·0
Marsh gas	13,063° ,,	104.504° ,,	8·0
Olefiant gas	11,858° ,,	166,012° ,,	14·0

The meaning of this table is simply that equal weights of water would be heated by the several gases to temperatures proportional to the numbers in the first column when equal *weights* of the gases are burned, and proportional to those in the second column when equal *volumes* are burned.

A cursory glance at the figures in the second column of this table might seem to justify the notion hitherto entertained by many of the comparatively-low calorific powers of hydrogen and carbonic oxide; and it was doubtless as a consequence of such a comparison as this that statements have been put forth and widely accepted among American gas-engineers to the effect that the weight of water heated from the freezing to the boiling-point by 1 cubic foot of the four main components of illuminating-gas, respectively, is as follows:—

Hydrogen	2·22 lbs. water
Carbonic oxide	2·16 ,,
Marsh gas	6·17 ,,
Olefiant gas	10·74 ,,

The figures here being obviously about in the same ratio as those in the second column of Table 1. Several most grave errors, however, are here involved. To get at the true relative calorific effects of the above gases, when burned in the open air, in heating water below its boiling-point, deductions must be made, not only for the *specific heats* of the products of combustion of the gas, but also (more important still) for the specific heat of the *nitrogen of the air* required to burn the gas. In fact, when we consider that, for each volume of oxygen required to burn a given volume of a gas, about *four volumes* of nitrogen must be heated up to the temperature of the flame, it becomes easy to conceive, what is actually the fact, that, within certain limits, the waste of heat due to this cause alone counterbalances altogether the advantage that would be supposed to result from the crowding of combustible matter into so condensed a form as in the illuminating hydrocarbons. An inevitable result of our investigations of this matter is that the heating powers of the flames of pure hydrogen and pure olefiant gas, even when used to the greatest advantage, to heat water below its boiling-point are almost or quite identical.

In this discussion we have occasion to use the numbers representing the specific heats of but *three* gases—the three, namely, which remain after complete combustion, *steam*, *carbonic acid*, and *nitrogen*; as we must assume that, in the hottest and most luminous zone or shelf of the flame, there is no oxygen in excess to be heated. These three numbers are, according to Regnault's latest determinations, for equal weights of—

Steam	0·4805
Carbonic acid	0·2163
Nitrogen	0·2438
(Liquid water being	1·0000)

This means that the amounts of heat which would raise 1 lb. of water and steam *to the same degree* are in the ratio of 0·4805 for the pound of steam, and 1 for the pound of water.

Calculation of the Calorific Effect of Hydrogen Burning in Air.

Let us take first the simplest case possible, that of hydrogen with exactly the right admixture of pure oxygen to burn it, which, by Table 1, develops a total heat of 34462° C., that is, would heat a certain weight of *liquid* water to this temperature. In order to find the actual amount of heat contained in the products of combustion, we must first take into account the fact that 1 lb. of hydrogen burns to *nine pounds* of steam, and then obtain the ratio between the above number, 34462, and the amount of heat necessary to heat nine times the weight of steam, that is, nine times the specific heat of steam. Calling the total residual heat in the produced steam x, we have the simple proportion—

9 × (sp. heat of steam = 0·4805) : 34462 : : (sp. heat of water = 1) : x;

Or—

$$x = \frac{34462°}{4·3245} = 7969° \text{ C.}^* = 14376° \text{ F.};$$

a number which, we may add, represents the *maximum* of heat capable of being imparted to *liquid water* by the flame of Hare's oxyhydrogen blowpipe.

Still, we have by no means here the actual temperature of the free or open flame of Hare's blowpipe, which is generally *lower* than this figure, as we have not yet taken into account the "latent heat," or heat of vaporisation, of the 9 lbs. of steam formed. The centigrade temperature necessary to convert 1 lb. of water into steam being 537°, to get the *actual temperature* of the oxhydrogen flame we must modify the above equation, so that—

$$x = \frac{34462° - (9 \times 537°)}{4·3245} = 6851° \text{ C.} = 12364° \text{ F.};$$

which is the temperature actually possible in the flame of the compound blowpipe, *were the combustion instantaneous and complete.*

When hydrogen gas burns in *air*, however, as has been before stated, another deduction of enormous amount must

* Bunsen, in his "Gasometry" (English edition of 1857, p. 242), gives this number as 8061° C., the difference being due to the use by him of a different number for the specific heat of steam, namely, 0·475, apparently an earlier determination of Regnault. Bunsen makes here the singular oversight of regarding this figure as the temperature when "the gases can freely expand, as is the case in an open flame," overlooking the correction necessary in this case for the *latent heat of steam of combustion*, as is explained in the text above.

be made from the above figures, due to the heat required to expand the nitrogen. This is obtained simply by adding to the divisor, as above, the weight of the nitrogen of the air employed, multiplied by its specific heat. The weight of the nitrogen in air = 3·318 times the oxygen; so that the latter of the above equations becomes—

$$x = \frac{34462^\circ - (9 \times 537^\circ)}{4{\cdot}3245 + (8 \times 3{\cdot}318 \times 0{\cdot}2438)} = 2744{\cdot}5^\circ \text{ C.} = 4972^\circ \text{ F.}$$

[We have here a full explanation of the extraordinary rate of degradation of illuminating-gas by admixture of air, which we have discussed elsewhere. The nitrogen of such air is not merely a dilutent, or even a mere deductive, quantity; its specific heat is an actual *divisory* function in diminishing the flame-temperature.]

This, then, is the actual temperature to which the flame of hydrogen gas burning in the atmosphere might attain to, supposing complete and instantaneous combustion. If it is desired to obtain, instead, the total calorific effectiveness, as in heating water below its boiling-point (in which case the latent heat of the steam of combustion becomes also available), the above expression is changed by simply omitting the subtrahend in the numerator—

$$x = \frac{34462^\circ}{4{\cdot}3245 + 6{\cdot}4714} = 3192^\circ \text{ C.} = 5778^\circ \text{ F.}$$

Calculation of Calorific Effect of Carbonic Oxide Burning in Air.

As the product of combustion is here solely carbonic acid, no latent heat of steam enters, and the calorific effectiveness is the same under all circumstances in air. In the numerator, we substitute, of course, the calorific equivalent of 1 volume of carbonic oxide from Table 1; and, in the denominator, for the specific heat of 9 lbs. of water, that of 22 lbs. of carbonic acid, being the weight of the latter formed by the combustion and combination of 14 lbs. (weight of a volume of carbonic oxide on the hydrogen-scale by third column of Table 1) of carbonic oxide with 8 lbs. of oxygen. The number for the specific heat of nitrogen is the same as before; and the equation is now—

$$x = \frac{33642^\circ}{(22 \times 0{\cdot}2163) + 6{\cdot}47 = 11{\cdot}23} = 2996^\circ \text{ C.} = 5425^\circ \text{ F.}$$

Marsh Gas and Olefiant Gas.

In these two cases, we have, as products of combustion, both carbonic acid and water; and, therefore, when the calorific effects are sought for, we have not only the latent heat of steam entering as a subtrahend into the numerator, but also into the denominator, as divisors, all three of the specific heats of steam, carbonic acid, and nitrogen.

Then, as 8 lbs. of marsh gas consume 22 lbs. of oxygen, and produce 22 lbs. of carbonic acid and 18 lbs. steam; and, as 14 lbs. of olefiant gas consume 48 lbs. of oxygen, producing 44 lbs. of carbonic acid and 18 lbs. of steam: the equations for the calorific powers of their flames in air become:—

For marsh gas—

$$x = \frac{104504^\circ - (18{\cdot} \times 537^\circ)}{(18{\cdot} \times {\cdot}4805) + (22{\cdot} \times {\cdot}2163) + (32{\cdot} \times 3{\cdot}318 \times {\cdot}2438)} = 2414^\circ \text{ C.} - 4386^\circ \text{ F.}$$

And for olefiant gas—

$$x = \frac{166012^\circ - (18 \times 537^\circ)}{(18{\cdot} \times {\cdot}4805) + (44{\cdot} \times {\cdot}2168) + (48{\cdot} \times 3{\cdot}318 \times {\cdot}2438)} = 2743^\circ \text{ C.} = 4970^\circ \text{ F.}$$

When the deduction for the latent heat of the steam of combustion is not made, the results in these two gases are considerably higher, as will be obvious from mere inspection of the formulæ.

We shall now give, in tabular form, all the results of our calculations of the calorific powers, when burning in the air, of the four gases we have to deal with.

TABLE II.

For equal volumes of the gases burning in air.	Calorific effects in heating liquid water.		Calorific effects above 100° C.	
	C.	F.	C.	F.
Hydrogen (Sp. heat, HO = 0·4805)	3192°	5778°	2744°	4971°
Hydrogen (Sp. heat, HO = 0·4750)	3204°	5799°	2755°	4991°
Hydrogen Mean	3198°	5788°	2749°	4980°
Carbonic oxide	2996°	5425°	2996°	5425°
Marsh gas (sp. heat, HO = 0·4805)	2660°	4820°	2414°	4386°
Olefiant gas (sp. heat, HO = 0·4805	2916°	5481°	2743°	4970°

Computation of Calorific Effects of Mixed Gases.

The above table renders the calculation of the calorific effects of any given gaseous mixture whose centesimal composition is known a matter of extreme simplicity. It is only necessary to obtain the sum of the multiples of the percentage of each component gas into its calorific capacity, as given in the Table, and divided by 100.*

To serve as examples of these modes of computation, we here cite, in tabular forms, the results of some analyses of a number of gaseous mixtures, made by us during the past winter (1868-9). [These analytical results, it may be remarked, possess points of novelty and importance, both scientific and practical, which will bring them up again, hereafter, in other connections. They are here placed on record.]

Table 3 gives the results of two analyses of gaseous mixtures obtained by passing steam, *superheated to incandescence*, upwards through a mass of *anthracite coal* heated to a high degree in a clay retort of a novel construction, according to what is now known as the "Gwynne-Harris" or American hydrocarbon-gas system. In this table the results are calculated without carbonic acid and sulphuretted hydrogen, which, with traces of nitrogen, and sometimes of oxygen, are found in the unpurified anthracite gas.

TABLE III.

Analysis of Anthracite Hydrocarbon-Gas.—By Silliman and Wurtz.

	1.	2.	Mean.
Hydrogen	60·43	59·32	59·87
Carbonic oxide	35·44	37·14	36·29
Marsh gas	4·13	3·54	3·84
	100·00	100·00	100·00

In Table 4, column 1 gives the results of the analysis of the street-gas served out at this period by the New Haven Gas-Light Company, made from Westmoreland coal, enriched with about 6 per cent of Albertite; column 2 the mean of four analyses of the completed hydrocarbon-gas made by us at Fair Haven during the same time, by combining gas from the same Westmoreland coal (with 10 per cent of Albertite) with half its volume of the anthracite gas. Columns 3 and 4 are obtained from 1 and 2 by centesimal reduction, after deduction of the illuminant ingredients, being what we propose to designate as the non-illuminating *substrata* of illuminating-gases.

* Prof. Bunsen, in the masterly discussion of the subject presented in his "Gasometry," not having in view the exact object we propose, has used a train of reasoning and a mode of formulation of some complexity, to follow which requires some little mathematical skill; part of his objects having been to construct a *formula* so general and comprehensive as to cover the direct computation, from any gaseous mixture independently, of its special calorific intensity. We have here aimed at so simplifying as to bring the whole subject within the capacity of all. Our above tabulation of the individual gaseous components, as a starting-point, seems, to us, to accomplish this most effectually, so far as illuminating-gases are concerned.

Table IV.

Gas Analyses.—By Silliman and Wurtz.

	New Haven city gas.	Fair Haven hydrocarbon gas.	Substratum of New Haven gas.	Substratum of Fair Haven gas.
	1.	2.	3.	4.
Hydrogen ..	43·58 ..	46·77 ..	46·79 ..	50·27
Carbonic oxide	2·14 ..	9·56 ..	2·31 ..	10·27
Marsh gas ..	47·42 ..	36·71 ..	50·90 ..	39·46
Illuminants ..	6·86 ..	6·96 ..	— ..	—
	100·00	100·00	100·00	100·00

Table 5 gives the results of the computation, from our *formulæ*, of the calorific powers of these five gaseous mixtures, for communicating temperatures both above and below that of aqueous ebullition. We should remark that we have been obliged to regard the volumes of *illuminant hydrocarbons* as representing olefiant gas solely, both because we have no certain data as to their real nature, and particularly because, if we actually knew or should assume the nature of the hydrocarbon-vapours present, still we have no experimental calorific equivalents, as we have for olefiant gas, from which to start in such a computation. We have reason to believe, nevertheless, that the errors thus introduced are not important in amount.

Table V.

	Weights of water equally heated below boiling; by equal volumes.	Weights of water equally heated above boiling; by equal volumes.	First column reduced to New Haven gas = 100.	Second column reduced to New Haven gas = 100.
Anthracite gas	3100 ..	2828 ..	104·2 ..	109·2
Substratum of the New Haven street-gas	2917 ..	2581 ..	98·1 ..	99·6
Substratum of the Fair Haven hydrocarbon gas	2962 ..	2640 ..	99·6 ..	102·0
New Haven gas (with the illuminants assumed = olefiant)	2974 ..	2592 ..	100·0 ..	100·0
Fair Haven gas (with the illuminants assumed = olefiant)	2959 ..	2647 ..	99·5 ..	102·1

Conclusions.

Some of the practical conclusions to which we are of necessity compelled by the results of the above investigations are somewhat remarkable; so that we feel diffident regarding them. It is, however, always safe to follow the leading of Truth, however astray she may conduct us from our preconceived notions.

From Table 2, it is apparent:—

1. That, of all known gases, the highest calorific effects, under ordinary atmospheric conditions, are obtainable from *carbonic oxide*, whose calorific value, above 100° C., is about 3000° C.

2. That, in absolute calorific value, below 100° C., in the atmospheric medium, *hydrogen* surpasses its volume of any other gas, giving a temperature of about 3200° C.

3. That for all modes of application—that is, for producing both high and low temperatures—the total maximum calorific effectiveness of carbonic oxide is a *constant quantity*.*

4. Compound condensed submultiple volumes of hydrogen, like that in marsh gas, have much *less* total calorific value in air than their volume of free hydrogen.

5. Condensed compound submultiple volumes of gaseous carbon, like that in olefiant gas, have no greater total calorific value in air, below 100° C., than their own volume of carbon gas in the form of carbonic oxide; while above 100° C. their value is even considerably less.

* Metallurgists, especially, will appreciate the suggestive import of the truths presented under the first and third heads; here enunciated, as we think, for the first time. It is to be noted that all the above effects belong to the *maximum* kind, and, of course, reach their development only under the most favourable conditions in each case respectively.

TANTALUM AND NIOBIUM.*

By Prof. ALBERT R. LEEDS.

In a long and interesting review of the great investigation of tantalum and niobium which occupied the last twenty years of H. Rose's life, Rammelsberg re-computes the formulæ according to the modern theories of chemistry, and shows that Rose's mistakes were not so much in the analyses as in the formulæ he deduced from them.† Blomstrand and Marignac have already pointed out that Rose fell into the error of regarding as a chloride what they demonstrated to be an oxychloride.

In order to obtain metallic tantalum, Berzelius heated tantalo-potassic fluoride with potassium: on treatment with water, there remained behind a heavy, black powder. H. Rose employed 3 parts tantalo-sodic fluoride and 1 part sodium: here, also, remained a heavy powder, which contained a considerable quantity of sodic bitantalate. Marignac reduced tantalo-potassic fluoride with aluminum: by treatment of the regulus with chlorhydric acid, a grey, crystalline powder remained behind of the composition Ta_2Al_3. Marignac did not succeed in preparing pure tantalum; and, up to the present time, it is unknown. The impure tantalum obtained by Rose conducted electricity very well; changed, with incandescence, on heating in the air, into tantalic acid; and was attacked by no acid except fluorhydric, and by that very slowly. The atomic weight of tantalum, as determined by the decomposition of tantalo-potassic fluoride into tantalic acid and potassic sulphate, was 182. Tantalic chloride was obtained by heating tantalic acid and carbon in an atmosphere of chlorine. It melts, according to Deville, at 241·6° C., and volatilises entirely, forming a crystalline sublimate. According to the same chemist, it fumes in the air, expels HCl, and covers itself with tantalic acid. Its formula, as derived by Rose from the amount of chlorine it yielded, is $TaCl_5$. To prepare pure tantalic acid, it is recommended to decompose tantalite by fusion with potassic bisulphate, and to fuse the salts which separate out with acid fluoride of potassium. The difficultly-soluble tantalate is allowed to crystallise out of the solution of the double fluorides, and is decomposed by heating with sulphuric acid, &c. It is white; when heated, faintly yellow; and has a formula, Ta_2O_5. Its numerous salts are arranged, by Rammelsberg, in five series, corresponding to the different stages of saturation of the acid.—*Journal of the Franklin Institute.*

* Communicated by Professor Morton.

† *Journ. für Prakt. Chem.*, 1869, p. 334.

CORRESPONDENCE.

ASSAY OF MANGANESE ORES.

To the Editor of the Chemical News.

Sir,—In his paper on the "Estimation of Peroxide of Manganese in Manganese Ores" (Chemical News, vol. xxi., p. 267), Mr. Pattinson points out a probable source of error in the Fresenius and Will method of testing manganese.

Speaking of hard ores containing magnetic oxide of iron, he says—"In order to affect their decomposition it is necessary to add a large quantity of sulphuric acid and to apply extraneous heat for a considerable time. It is probable that during this lengthened heating steam is allowed to escape with the carbonic acid, and hence a higher amount of peroxide is indicated than is present in the ore."

That this could not have been the cause of the higher results obtained by this method, in the experiments given in the paper on the "Estimation of Peroxide of Manganese

in Manganese Ores" (CHEMICAL NEWS, vol. xx., p. 302), is evident from the fact that in the three tests there given, extraneous heat was in no case applied to the apparatus, and, therefore, the boiling-point was not reached.

I have since tested three different samples of manganese by the Bunsen and by Fresenius and Will's method, which, by the latter, gave results from 1 to 1½ per cent higher than by the former, and in testing them by Fresenius and Will's method I took the precaution of connecting the apparatus with weighed chloride of calcium tubes during the heating and drawing of air through the apparatus, and found after repeated heating to the boiling-point, no increase in the weight of the chloride of calcium tubes, and no decrease in the weight of the apparatus. The higher results obtained in these cases by the Fresenius and Will's method cannot, therefore, be due to the escape of steam.

I have tried the method described by Mr. Pattinson, and obtained results agreeing very closely with each other.—I am, &c.,

EDWARD SHERER.

June 11th, 1870.

THE ENGLISH COMMERCIAL SODA-TEST.

To the Editor of the Chemical News.

SIR,—My attention has lately been drawn to a strange error made by some analysts in attempting to apply the English commercial test for soda to samples of alkali, soda-ash, &c., the result of which error is to make the test indicate from 1 to 1½ per cent more soda than the sample contains by the proper English test. It is well known that this (the English soda-test) had its origin in the early days of the soda trade—when chemists believed the equivalent of soda to be 32, and that of carbonate of soda 54; and that, consequently, test acid was made so that 40 parts of sulphuric acid neutralised 54 parts of carbonate of soda equal to 32 of soda. This method of testing has always been, and still is, used by the soda trade throughout England; and it is a custom well understood by both buyers and sellers. It indicates 0·66 per cent more soda in a 50 per cent alkali, than the rigidly-correct test based on the new equivalent 31 would indicate. It is certainly desirable, for the sake of scientific accuracy, that the correct equivalent, 31, should be used in testing; but, seeing that manufacturers have expended their capital in plant, and made their contracts for their various materials on the understanding that a product containing a certain percentage of soda would be obtained, and, seeing that there are other commercial customs of the trade still in force, which tell as much against the manufacturer as the test does in his favour—such, for instance, as that of not charging for fractions of percentages, it is more the province of an association like the Alkali Manufacturers' Association, than that of an analytical chemist, to make alterations in trade usages affecting such vast interests. Certainly, if any alteration be made at all by chemists, it should be made in the direction of scientific accuracy, and not in the contrary direction, as in the case to which I have referred. The error, I find, arises in this way: The test-acid is made so as to indicate the exact amount of soda according to the new and correct equivalent 31—that is, that 40 parts of sulphuric acid should neutralise 53 parts of carbonate of soda, equal to 31 parts of soda.

To convert the results obtained by this test-acid into the English commercial soda-test, it is incorrectly assumed that the 31 parts of soda are equal to 32,—in other words, that the 53 parts of carbonate of soda contain 32 parts of soda. This is where the error lies; for, according to the correct English test, 54 parts of carbonate of soda, and not 53, contain 32 of soda; and, therefore, by the English test, 53 parts of carbonate of soda contain only 31·41 of soda. By thus mixing up the old and the new systems of equivalents, a sample of soda-ash which, by the correct English test, contains 50·66 per cent would be returned as containing 51·61 per cent of soda. A sample of caustic soda which, by the correct English test, would contain 75·0 per cent of soda would, by this erroneous method, indicate 76·4 per cent. It is only necessary to point out this error in order that it may be avoided and guarded against by any of your readers interested in the buying and selling of alkalies.—I am, &c.,

JOHN PATTINSON.

Newcastle-upon-Tyne,
June 7th, 1870.

MISCELLANEOUS.

Double Sulphide of Potassium and Iron.*—By heating an intimate mixture of 5 parts of sulphur, 5 of potassic carbonate and 1 part of fine iron-filings, C. Preiss has succeeded in forming a double sulphide of potassium and iron, which crystallises in red needles, has a metallic lustre, and resembles in appearance potassic permanganate. Its formula is KS,Fe_2S_3.† The same compound has been obtained independently by R. Schneider, who also has formed, by the replacement of iron by bismuth, the analogous compound, $KS.Bi_2S_3$.—*Pogg. Ann.*

Application of Mica as a Substitute for Bronze.*—A means has been found of greatly increasing the value of mica, by converting it into a colouring material. The mica is reduced to small pieces in a stamping mill, digested with chlorhydric acid, cleansed by washing and sorted by sieves into sizes. The mica scales so prepared have a beautiful vitreous lustre, a silvery appearance, and bear in commerce the name of Brocade Crystal Colours or Mica Bronzes. The advantages of these brocades over the common metallic ones are:—(1). They contain no unwholesome substance. (2). They possess a metallic lustre like the metallic brocades, and much surpass them in splendour. (3). Brown, blue, black, green, and red colours of rare brilliancy can be obtained, which is not the case with the metallic brocades. (4). They are not dimmed by sulphur vapours. The analyses by Dr. Cech and Schneider show that the colouring matter of the rose-brocade is cochineal; that of carmine is fuchsine; bright red, fuchsine and Havanna brown; violet, Hofmann's violet; bright blue, Berlin blue; dark blue, probably impure aniline blue or Girard's violet; light and dark green, a mixture of aniline blue and curcuma; gold, curcuma; silver, the mica alone, &c.—*Journ. für Prakt. Chemie.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, June 6, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and collateral sciences:—

Action of Water upon Iron, and of Hydrogen upon the Oxide of Iron.—H. Sainte-Claire Deville.—(Second paper on this subject.) The author describes at length the phenomena observed when iron is heated to 150°, 265°, 440°, 860°, 1040°, and, lastly, to the highest temperature porcelain can bear without becoming soft—first, leaving the tension of the vapour constant; and, secondly, varying it. Curiously enough, the author finds that, the higher the temperature iron is heated

* Communicated by Professor Morton.
† *Journ. für Prakt. Chemie*, cvii., p. 10.

to, the less it decomposes water; in chemical parlance, the author says, we should say that the affinity of iron for the oxygen of water decreases with the increase of temperature. The lengthy memoir contains a series of tabulated results of experiments; and the author winds up with a metaphysical discussion on the real signification of force.

Reduction of Nitrous Acid by Metals.—E. Fremy.—The author, referring to his former paper on this subject, now states that the oxy-ammonia discovered by M. Lossen, and also obtained by the author as the result of the decomposition of nitrous acid, was now prepared on purpose, by causing a mixture of chlorhydric acid and tin to act upon the nitric ether of wood-spirit; and, on studying its properties, he finds these to agree with what has already been said. The author then describes the action of sodium-amalgam upon a nitrate, which is thereby first converted into a nitrite, and this, in its turn, into oxy-ammonia, nitrogen, and protoxide of nitrogen, which gas, however, remains in solution in the alkaline liquid.

Optical Properties of Benzyl, and of some Substances belonging to the Camphor Groups, in the Crystalline State and in Solution.—M. Des Cloizeaux.—In this lengthy memoir, the author describes a series of experiments, the chief results of which are that benzyl and periodate of soda possess, when in solid crystalline state, strongly-marked rotatory powers, and are devoid thereof in the state of solution. Quartz, chlorate, and bromate of soda act the same. Sulphate of strychnia possesses rotatory powers, in crystalline as well as in dissolved state; while ordinary camphor, patchouli camphor, camphor (stearopten) of oil of mint, Borneo camphor, terecamphen, and monochlorhydrate of turpentine, possess rotatory power when in solution, but not in crystalline state.

Displacement of the Rays observed in the Solar Spectrum.—A letter to M. Fizeau on this subject from the Rev. Father A. Secchi, S.J.

Rectification of some Dates relating to the Rev. M. Grandillon's Life.—A. Georget.—The author states that the Rev. M. Grandillon was Professor of Natural Philosophy at Orleans in 1617; from 1619—1623, he was successively Professor of Logic, Metaphysics, and Divinity at La Flèche; in 1624 and 1625, Professor of Divinity at Paris; 1626 and 1627, Prefectus Studiorum and Concionator at Bourges; from 1628—1630, Rector at Alençon, where he died on the 29th of October, 1631. He was a Roman Catholic priest, and a member of the Order of Jesuits before 1614, and was, about that year, Reader on Philosophy at Paris. From a foot-note added to this notice, we learn that the dates alluded to are the authentic figures extracted from the official documents in the possession of the Society of Jesus.

Insalubrity of the Water of the River Croult, and on the means of Preventing its Pollution by the Refuse from Starch Manufactories.—M. Gérardin.—Only the title is given of this paper.

Formation of Blood Globules.—Dr. Felz.—The author states that, from some observations made by him, these globules are formed also outside of the blood vessels, but are not then coloured. He quotes, as instances, the presence of white blood globules in the tissue of the cornea of the eye, cartilage, and similar tissues.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, 1870.

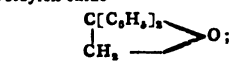
This number contains the following original papers and memoirs:—

Action of Chlorine upon Aldehyde: a New Chloral.—G. Krämer and A. Pinner.—The authors relate, at great length, a series of experiments made by them with some peculiar by-products obtained in the industrial manufacture of aldehyde, as now carried on in Germany. These products appeared to be perfectly useless, even for burning in spirit-lamps; and, hence, the authors investigated the possibility of applying that substance to the preparation of chloral (hydrate of). In the course of these researches, they obtained what they call a new chloral—after purification, a colourless oily fluid—which absorbs water with great avidity; but, when a single drop of that fluid is added to some of the oily liquid, it does not mix therewith. On being, however, stirred together, heat is evolved, and the mixture solidifies, forming a solid crystalline mass. The body also combines with alcohol; its percentage composition is—Carbon, 27·56; hydrogen, 3·07; chlorine, 60·4; vapour density, 86·01. These figures, the authors say, suit croton-chloral as well as butyl-chloral—the former being $C_4H_5Cl_3O$, carbon, 27·66; hydrogen, 1·71; chlorine, 61·38—the latter, $C_4H_7Cl_3O$. The further researches on this subject have proved the new body to be the croton-chloral. A chloride of this substance was obtained, and an acid, which undoubtedly proved that a new chloral had been discovered.

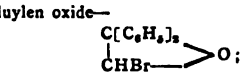
Quantitative Estimation of Glacial Acetic Acid.—F. Rüdorff. The author preliminarily refers to the usual methods of the estimation in question, by means of a titrated soda solution, stating it to be unsatisfactory; and next mentions that his method is based upon the estimation of the freezing-point of the acid in question. The author enters at length into the details of his experiments, the chief point of interest of which is that *perfectly* pure and *anhydrous* acetic acid solidifies at 16·7°; that if either water, alcohol, some salts, or sulphuric acid are present, these substances tend to lower the point of solidification, so that 100 parts of the pure acid, mixed with 24 of water, solidifies at −7·4°.

Action of Bromine upon Dichlorhydrine.—L. Carius.—After referring to some former experiments on this subject, the author describes dichlor-dibromaceton, $C_3H_2Cl_2Br_2O$, a heavy liquid, not freezing at −10°, and not boiling without decomposition. When combined with water, this substance forms a solid body, $C_3H_2Cl_2Br_2O+(OH_2)_4$, containing 20·17 per cent of water of crystallisation.

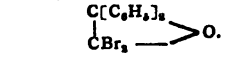
Toluylen Oxide.—H. Limpricht.—The author describes at length, and with the use of a lengthy series of complicated formulæ, the constitution of—Toluylen oxide—



bromated toluylen oxide—



double bromated toluylen oxide—



The bromated body is a solid, fusing at 50°, crystalline, and giving off bromine at 160° when heated along with water, or at 150° when heated along with alcoholic potassa solution. The bibromated compound is also a solid, crystallising in prismatic-shaped crystals, and fusing at 110°. The author refers to, and to some extent corrects, the statements made by Dr. Zinin in reference to the constitution of these compounds and their connection with other chemical compounds.

Preparation of Hydrated Hydrobromic Acid.—H. Topsöe.—After referring, at some length, to the various modifications made by several authors, among which Drs. Gladstone, Kekulé, Mène, and others, in the preparation of the acid referred to, the author states that, according to his researches, the following mixture suits the purpose best:—Amorphous phosphorus, 1 part; bromine, 10 parts; water, 15 parts (of the latter fluid, a portion is to be placed in the receiver). On distilling this mixture, a colourless fluid is obtained, which becomes gradually stronger (containing more anhydrous acid) until the boiling-point reaches 125°. The acid obtained at that temperature has a sp. gr. of 1·49, and contains 48·17 per cent of anhydrous hydrobromic acid.

Tabulated Forms Exhibiting the Specific Gravity and Percentage Composition of Hydriodic and Hydrobromic Acids at Various Temperatures.—H. Topsöe.—The strongest hydrated hydriodic acid which can be obtained boils at 127°, contains 57·75 per cent of anhydrous hydriodic acid, and its equivalent is 221·7. The equivalent of the strongest hydrated hydrobromic acid just alluded to is 168·2.

Chemical Constitution of Acroleine.—A. Claus.

Source of Error occasioned by the Use of Pettenkofer's Respiration Apparatus.—W. Henneberg.

Contribution to our Knowledge of the Synthesis of Cinnamic Acid.—H. Schiff.—With this, as with many other papers, the great length and large space taken up by a series of very complex formulæ, render any useful abstraction of them impossible.

On Benzilic Acid.—A. Jena.—The author refers, first, to his former researches on this subject, and then states that he has prepared the baryta-salt of this acid, $(C_{14}H_{11}O_3)_2Ba$, a crystalline solid substance, readily soluble in water, decomposed, by distillation, into carbonic acid and benzhydrol—

$$\underbrace{C_{14}H_{12}O_2}_{\text{Diphenyl-glycolic acid.}} = CO_2 + \underbrace{C_{13}H_{12}O}_{\text{Benzhydrol.}}$$

The author says that the formula to be assigned to benzilic acid is that which considers it to be diphenyl-glycolic acid.

As a curiosity, we may mention that, from the correspondence of this Society's agents, the gentleman holding that position at St. Petersburg mentions the labours of Lady Anna Wolkow—

On Isomeric Toluol-Sulpho Acids.—The authoress, having very successfully completed and augmented, by interesting discoveries, the labours on this subject of Drs. Engelhardt and Latschinow. The lady is a member of the Imperial Russian Chemical Society.

Annalen der Physik und Chemie, von Poggendorff, No. 4, 1870.

This number contains the following original papers and memoirs:—

Rotation Phenomenon of Holtz's Machine.—J. C. Poggendorff.

Composition and Constitution of Tourmaline.—Dr. C. Rammelsberg.—The last instalment of this lengthy chemico-mineralogical essay.

Emission, Absorption, and Reflection of the Heat Radiated at Low Temperatures.—G. Magnus.—The last instalment of this lengthy memoir is divided into the following sections:—On reflection of heat; description of experiments; reflection from the surface of other substances than silver, glass, rock-salt, and sylvine; reflection under various angles; results.

Theory of Colours.—Dr. J. J. Müller.—Concluding portion of the memoir on this subject, divided into the following chapters:—On the fluorescence of the retina, as dependent upon the length of waves and the intensity of the light; on the table of colours; physiology of the theory of colours.

Free Rotation of the Movable Conductor and of the Solenoïde of Ampère's Apparatus.—Dr. G. Krebs.—Illustrated with engravings.

Tension of Thin Fluid-Plates.—R. Lüdtge.

Influence of the Temperature on the Sensitiveness and Delicacy of Spectrum Reactions.—E. Cappel.—The main result which can be drawn from this lengthy paper is, that the temperature most suitable for the spectrum analysis of the alkalies is that of the oxyhydrogen flame; and, for the rest of the metals, the heat of the electric spark is most suitable. The higher the temperature, the more distinct the reactions.

Knochenhauer's Comparison of the Theory and Practice for the Oscillatory Electric Discharges in a Curved and Ramified Closed Conducting Wire.—W. Feddersen.

Floating of Solid Iron upon the Molten Metal, and Observations on the Trèves Experiment.—Dr. L. Overzier.

New Sulphur Salts.—R. Schneider.—(Fourth paper.) Among the large number of salts of this kind discovered by the author, we mention briefly—Cuproplatin-sulphoplatinate—

$$\overset{II}{Cu}S,\overset{II}{Cu}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \}PtS_3;$$

equivalent, 911·2; in percentages—Copper, 13·93; platinum, 64·99; sulphur, 21·08. Plumbo-platin-sulphoplatinate—

$$\overset{II}{Pb}S,\overset{II}{Pb}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \}PtS_3;$$

equivalent, 1199·2; in percentages—Lead, 34·58; platinum, 49·35; sulphur, 16·07. Mercuro-platin-sulphoplatinate *cum* mercuro-chloride—

$$2HgS,2\overset{II}{Pt}S \}\overset{IV}{Pt}S_3+2HgCl_2;$$

in percentages—Platinum, 34·34; mercury, 46·32; chlorine, 8·22; sulphur, 11·12.

Acoustic Attraction and Repulsion.—K. H. Schelbach.

Flexive Power Exerted by the Contraction of the Muscles.—Dr. R. Most.—An algebraico-physiological paper.

Memoir of the Life of the Late Professor Magnus.—Dr. Poggendorff.

Journal für Praktische Chemie (double number), Nos. 6 and 7, 1870

This number contains the following original papers and memoirs:—

Persulphocyanic Acid and Pseudo-Sulphocyanogen.—Dr. L. Glutz.—Continuation and end of this memoir.

Action of Anhydrous Sulphuric Acid on some of the Chlorine and Sulphur Compounds.—Dr. H. E. Armstrong.—This lengthy memoir is divided into the following sections:—Action of sulphuric anhydride upon tetrachloride of carbon; action of sulphuric anhydride upon chlorobenzol, benzo-trichloride, and dichlorhydrine; action of sulphuric anhydride upon hexachlorbenzol; action of sulphuric anhydride upon sesquichloride of carbon; action of sulphuric anhydride upon sulphide of carbon; action of sulphuric anhydride upon protochloride of phosphorus; properties and reactions of pyrosulpho-chloride.

Causes and Nature of Chemical Combinations.—Dr. Mohr.

Direct Preparation of Urea from Carbonic Acid and Ammonia.—A. Basaroft.

Some of the Derivatives of Cyanamide.—H. Kolbe.—This lengthy paper is divided into the following sections:—Dicyandiamide and dicyandiamidine; cyanurea; dicyanic acid; amidocyanic acid; glycocíamine and kreatinine.

Hydrogenium-Amalgam.—O. Loew.—Hydrogenium-amalgam is prepared by shaking together, in a vessel to be kept very cool, a mixture of mercury containing from 1 to 2 per cent of metallic zinc, along with an equal bulk of a solution of chloride of platinum containing 10 per cent of solid chloride. A slimy mass is obtained, devoid of metallic lustre and prone to decomposition, owing to the presence of some zinc and some compounds of that metal; but, on treating the mass with dilute hydrochloric acid, a body having the consistence of butter is obtained, which, according to the author, is a true amalgam of mercury and hydrogenium. The author describes at length several reactions of this body, which, in many of its properties, is akin to hydrogenium-palladium.

Bulletin Mensuel de la Société Chimique de Paris, May, 1870.

This number contains the following original papers and memoirs:—

Trichlorhydrine and Substances Isomeric with it.—M. Berthelot.—The author says—Trichlorhydrine, a body consisting of carbon, hydrogen, and chlorine, is prepared from glycerine and hydrochloric acid—

$$C_6H_8O_6+3HCl-3H_2O_2=C_6H_5Cl_3.$$

But this composition and formula also belong to a series of other bodies, among which those obtained by the following reactions:—The action of chlorine upon the chloride of propylen; action of chlorine upon the chlorinated propylen derived from acetone; action of chlorine upon allyl-iodhydric ether, isopropyl-iodhydric ether, and hydruret of propylen; action of perchloride of phosphorus upon acroleine, &c. The author describes at length the comparative investigations made by him on this subject, and summarises the results by stating that trichlorhydrine has not been hitherto produced but from substances which take their origin from glycerine, while there exist at least five series of isomeric chlorinated substances—viz., the derivatives of the hydruret of propylen, C_6H_8; the derivatives of the chlorhydrate of propylen, $C_6H_8.HCl$; the derivatives of the normal chloride of propylen, $C_6H_6Cl_2$; the derivatives of the isochloride of propylen; the derivatives of trichlorhydrine corresponding to the glycerine.

On Tribromhydrine.—M. Berthelot.—This paper is a refutation of what has been published by M. Henry on this subject.

Reaction between Oxychloride of Carbon and Benzine.—M. Berthelot.—The result of the author's researches, undertaken with the view to test the accuracy of the results of some investigations made on this subject by Dr. Graebe, is to the effect that free oxychloride of carbon does not, at any temperature whatever, when acting upon benzine, form benzoic chloride.

Substances Isomeric with Trichlorhydrine.—M. Berthelot.—This lengthy essay contains the theoretical discussion on this subject. As might be expected, the paper abounds with formulæ.

Glycol and Octylic Chlorhydrine.—P. de Clermont.—This paper is divided into the following sections:—Action of nitric acid upon octylic glycol; chlorhydrine of octylic glycol.

General Theory of Chemical Action: Action of Chloral upon Aniline.—E. J. Maumené.—The author desires to prove (and this is demonstrated with a series of formulæ) that it may be possible to obtain indigo artificially, by the action of chloral upon aniline; but the practical experiments of the author, as related, do not at all lead to this result.

Les Mondes, May 26, 1870.

Chemically-Prepared Bread.—Dr. Sacc.—The author, writing to the editor, and sending, also, a sample of the bread prepared, says—We are acquainted with bread prepared with substances capable of evolving carbonic acid to render the bread spongy; but, since in bread so prepared the gluten and starch are not, as is the case in bread fermented with yeast, rendered partly soluble, such bread is heavy, and, instead of swelling up, if put into soup it crumbles away and disintegrates. I have tried to remedy this defect, well knowing that chemistry gives us the means and suitable materials to effect the same change as yeast does; and I make use of cheap, simple, and healthy substances, obtainable everywhere (but not further specified). The editor of *Les Mondes* states that the sample of the bread sent him, although it had become dry and stale, was excellent in every respect, but, perhaps, a little too salt for those accustomed to the bread of Paris.

Preparation of Optically-Neutral Sugar.—E. J. Maumené.—The author mixes equal parts of pure sugar candy and neutral nitrate of silver, both previously dissolved in water, and evaporates the mixture upon a water-bath. He states that, neither at 100°, nor even at 140°, any decomposition ensues, or any reduction of silver takes place, provided the sugar be free from inverted sugar. The author confirms, what was found twenty years ago by Dr. G. Mulder, that sugar candy (white) and best refined lump sugar, do not contain any trace of glucose. The sugar rendered syrupy by the process described is optically neutral. The silver-salt is separated from the sugar by means of pure chloride of calcium, and the nitrate of lime is separated from the sugar by the addition of alcohol, and placing this mixture under a bell-jar along with quick-lime. In this manner, by slow concentration, two layers, of different specific gravity, are formed; the upper being an alcoholic solution of nitrate of lime, the lower a viscous saccharine liquid. The former is poured off, and, by a slight washing with cold distilled water, the thick sugar solution is freed from any adhering nitrate of lime. The sugar obtained does not crystallise, does not act upon the cupro-potassic liquor, and readily combines with lime, which base is completely withdrawn by the action of carbonic acid.

June 2, 1870.

Success of a Missionary who Loves Science.—Rev. F. Moigno.—Under this title, the author relates some curiosities of the success obtained by the Rev. A. David, who, as a missionary of the Lazarist Society, has explored Central Asia (Thibet, Mongolia, China), and has brought to Europe a large number of specimens of plants and animals hitherto unknown to Western civilisation. We particularly call attention to this paper, because it contains some very curious statements about a deer-park existing near Pekin, surrounded by a high wall, no less than about 32 miles in circumference, and containing various species of large mammalia not hitherto seen elsewhere. It is rather strange that, since Pekin is the abode of several European Embassies (a French one to boot), the existence of this place *à quelques pas aussi* of Pekin should not have been long since known.

New Manure (Courrière Guano).—MM. A. Tilloy-Delaune and Co.—It appears that Indian corn (*zea mais*) has been, and is now largely used in French distilleries. This grain, previously coarsely broken, is boiled with dilute sulphuric acid, in order to convert its starch into sugar. After fermentation, however, the residue of the distillation is not suitable for feeding cattle. The firm alluded to, large distillers at Courrières (Pas de Calais), run the refuse from the stills into large tanks, and, after all solid matters have subsided, run off the clear liquid, and obtain a residue containing the following percentages:—Water, 8·77; organic matters (inclusive 4·68 nitrogen), 68·35; mineral matters, 18·58; yielding an excellent manure.

Meteorites Observed from November 14th, 1869, to March 11th, 1870.—Rev. Father P. Denza, S.J.—Astronomically-observed meteorites at Moncalieri (Italy).

Improved Centrifugal Pump.—M. Coudurier.—This memoir, illustrated with several excellent woodcuts, states that the pumps alluded to are superior in effect, and surpass in simplicity of construction and force of action any hitherto made. Particulars may be obtained by addressing M. Coignard, 68, Boulevard du Prince Eugène, Paris.

Fermentation and Small Organisms.—E. Du Mesnil.—This rather lengthy paper contains some very curious opinions on fermentation, which is, according to the author's ideas, the joint-work of electricity, magnetism, and ammonia, acting together in a very complex and not well defined manner.

Revue Hebdomadaire de Chimie, May 26, 1870.

Ice-Making Machine and Cooling Apparatus for Brewer's Wort.—L. Martin and M. Vindhaussen.—Lengthy and full description of two apparatus based upon the principle that, if the expansion of a gas (atmospheric air, in this instance) is effected by mechanical means, absorption of heat—in other words, production of cold—takes place. The ice-making machine produces 100 kilos. of ice at a cost of about sixpence. The cooling apparatus is so arranged as to effect a drying of the malt and cool the wort at the same time.

Ammonia Machine.—M. Frot.—The first portion of a paper describing a contrivance wherein ammonia is employed instead of steam for the same purposes for which the latter is now applied.

Chemists' and Mineralogists' Travelling Companion.—MM. Alvergniat.—This paper, accompanied by a woodcut, gives the detailed description of a very neatly-arranged box, 50 by 30 and 20 centimetres, weighing, when full, only 3 kilos., and containing all the necessary requisites for chemical or mineralogical research on a journey and at a distance from laboratories. The makers are celebrated for their goods; the price (not specified) is said to be very moderate.

Tanning by the Aid of Carbonic Acid.—M. Polefroy.—This process consists in submitting the hides (previously limed) to the action of a strong current of carbonic acid, in order to dissolve the tannate of lime first formed, and to aid the penetration of the tannic acid in the skins and hides.

So-called Cold Galvanisation of Iron and Cast-Iron.—V. Roque.—The iron is first cleaned by being placed in a bath made up of—Water, 1000 litres; chlorhydric acid, 550 litres; sulphuric acid, 50 litres; glycerine, 20 litres. On being removed from this bath, the metal is placed in a bath containing 10 per cent of carbonate of potassa, and is next transferred to a metallising bath consisting of—Water, 1000 litres; chloride of tin, 5 kilos.; chloride of zinc, 4 kilos.; bitartrate of potassa, 8 kilos.; acid sulphate of alumina, 4 kilos.; chloride of aluminium, 10 kilos. The metal has to be left in this mixture for from three to twelve hours, according to the thickness of the layer of zinc to be desired.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, March, 1870.

This number contains the following original papers and memoirs relating to chemistry:—

Substituted Melamines.—Dr. A. W. Hofmann.

Bodies Isomeric with Cyanuric Acid Ether.—Drs. A. W. Hofmann and O. Olshausen.—Both these memoirs are too lengthy for any useful abstraction.

Distribution of the Temperature of Central Europe during the past Winter.—Dr. Dove.—From the various meteorological phenomena observed, the author draws the conclusion that any abnormally-low temperature in Europe travels from the east to the west, while any subsequent abnormally-high temperature moves from the west to the east. The observations quoted in this paper extend over almost the whole of Europe and a large portion of the United States of America.

Revue des Cours Scientifiques de la France et de l'Etranger, May 28, 1870.

Although this number does not contain any paper relating directly to chemistry, we must not omit to quote—

Condition of Sciences during the Middle Ages.—Dr. H. Kopp.—This lecture of the well-known author of the excellent "Geschichte der Chemie," is a very valuable contribution to our knowledge of the history of sciences, as well as to the organisation of the more ancient universities of Europe. We regret that the length of the discourse prevents us entering into details, many of which are interesting as well as amusing.

June 4, 1870.

This number contains the first of a series of lectures on the—

Isomerism of the Elementary Bodies; Different States of Existence of Oxygen.—Dr. Berthelot.—We regret that the length of this paper (a verbatim report) forbids our entering into any detailed abstraction as regards ozone. The author says that there exists, at least in some cases, a certain relation between the states (allotropism of Berzelius) of an element in free state, and the nature of the combination from which it is disengaged; that an elementary body in a certain state can more readily enter into one kind of combination than in another; that an elementary body can change (can become allotropic) simultaneously whilst it is in combination with another body.

Moniteur Scientifique, No. 323, June 1, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Influence of the Motion (that is to say, swift movement in a certain direction) of a Source of Sound or Light upon the Sound or Light Emitted from the Object in Motion.—R. Radan.—This paper refers to the researches of Dr. Doppler, made in 1842; those of Dr. Buijs-Ballot, made in 1845, upon the Dutch-Rhenish railway; and to the experiments made by M. Fizeau, and many other *savants*, on this subject.

Critical Essay on M. J. Raulin's Labours on Vegetation.—F. Papillon.—A very lengthy memoir.

NOTES AND QUERIES.

Bauxite.—If "J. B. S." will write to Dr. Lunge, South Shields, he will learn where this mineral can be obtained on a large scale.

Phosphate of Ammonia.—Will the gentleman who answered an enquiry regarding the manufacture of phosphate of ammonia oblige by giving details of the process, or state where full information may be obtained?—J. W. M.

The Metric System.—Observing Mr. Woodward's note in the CHEMICAL NEWS (vol. xxi., p. 273), I beg to suggest the following abbreviations, in place of those used by M. Evers, for the terms employed in the metric system of weights and measures:—Myriametre, mym.; kilometre, kim.; hectometre, hem.; decametre, dem.; metre, m.; decimetre, dm.; centimetre, cm.; millimetre, mm.; square kilometre, sq. kim., or $kim._2$; square metre, sq. m., or $m._2$; square centimetre, sq. cm., or $cm._2$; stère or cubic metre, s. or c.m., or $m._3$; cubic centimetre, c.cm., or $cm._3$; cubic millimetre, c.mm., or $mm._3$; kilolitre, kil.; hectolitre, hel.; kilogramme, kigm.; gramme, gm.; decigramme, dgm.; centigramme, cgm.; milligramme, mgm. The Greek prefixes, which denote multiples, are thus represented by their first two letters; and the Latin prefixes, which denote sub-divisions, indicated by their first letter: gramme is gm., as gr. would still be required for grain.—J. CURRIE.

MEETINGS FOR THE WEEK.

MONDAY, June 20th.—London Institution, 8.
TUESDAY, 21st.—Ethnological, 8.
WEDNESDAY, 22nd.—Geological, 8.
THURSDAY, 23rd.—Royal Society Club, 6.30. Anniversary.
—— Zoological, 8.30.
FRIDAY, 24th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

Frank H. Storer is thanked for his valued communication. We hope for more anon, as promised.

J. Pattinson.—Thanks for your communication; it shall receive attention.

Hyposulphite of Soda alone is of no use in dyeing hair; it requires the addition of a lead solution. You had better write to the journal in which you saw the statement.

W. H. Walenn.—Received, with thanks.

J. F. Hill.—Apply to Roberts, Dale, and Co., Cornbrook Chemical Works, Manchester.

Chartism.—The reactions are very simple, and are to be found in every book on analysis.

J. Currie.—Mr. J. C. Morton's "Cyclopœdia of Agriculture" will probably meet your requirements; it is published in 2 vols. by Blackie and Son. Baxter's "Library of Agriculture," 2 vols. (Simpkin and Co.); "The Rural Cyclopœdia," by the Rev. J. Wilson, 3 vols. (Fullarton and Co.); and Doyle's "Cyclopœdia of Practical Husbandry," published by H. G. Bohn, are also good books on the subject.

BOOKS RECEIVED.

Researches on Diamagnetism and Magne-Crystallic Action, including the Question of Diamagnetic Polarity. By John Tyndall, LL.D., F.R.S. London: Longmans and Co.

Notes of a Course of Nine Lectures on Light, delivered at the Royal Institution of Great Britain, April—June, 1869. By John Tyndall, LL.D., F.R.S. London: Longmans and Co.

Water Analysis: a Practical Treatise on the Examination of Potable Water. By J. Alfred Wanklyn, M.R.C.S., late Professor of Chemistry to the London Institution; and Ernest Theophron Chapman. 2nd Edition, Edited by E. T. Chapman. London: Trübner. 1870.

THE CHEMICAL NEWS.

VOL. XXI. No. 552.

ON THE

AMMONIA COMPOUNDS OF PLATINUM.*

By WILLIAM ODLING, M.B., F.R.S.,
Fullerian Professor of Chemistry, Royal Institution.

FOR nearly a century past ammonia gas, discovered by Priestley in 1774, has been a subject of extreme interest to chemists. This ammonia gas, H_3N, is especially characterised by its property of uniting directly with hydrochloric acid gas, HCl, to form a solid deposit of sal-ammoniac, or hydrochloride of ammonia, $H_3N.HCl$.

In several important particulars, sal-ammoniac presents a remarkable similarity of behaviour to chloride of potassium: and by linking together the hydrogen of its acid with its ammonia so as to form the grouping $H_3N.H$ or H_4N, it may be regarded as the chloride of a composite metal ammonium, just as potassium chloride is the chloride of the simple metal potassium; thus:—

$$(H_3N.H)Cl \qquad KCl.$$

Ordinarily, when potassium chloride is subjected to the action of a weak current, no potassium, but only potash, makes its appearance at the negative pole; but if the negative pole be constituted of a drop of mercury, the electrolytically-liberated potassium remains dissolved in the mercury as potassium-amalgam, K_xHg_y. Similarly, when solution of sal-ammoniac is subjected to electrolysis, the negative pole being constituted of mercury, there is produced a bulky amalgam of ammonium $(H_3N.H)_xHg_y$; which, however, when no longer under the influence of the current, speedily breaks up into ammonia, hydrogen, and mercury. Ammonium-amalgam may further be produced on a large scale by the action of potassium-amalgam or sodium-amalgam on sal-ammoniac solution, thus:—

$$x(H_3N.H)Cl + K_xHg_y = xKCl + (H_3N.H)_xHg_y.$$

Another characteristic property of ammonia gas is its extreme solubility in water. By its dissolution it furnishes a liquid having many of the properties of aqueous potash, as, for example, the properties of affecting test-paper, of neutralising acids, and of precipitating metallic salts. And just as sal-ammoniac may be regarded as a chloride of ammonium, analogous to chloride of potassium, so may aqueous ammonia be regarded as a hydrate of ammonium analogous to hydrate of potassium, thus:—

$$(H_3N.H)HO \qquad KHO.$$

But whereas chloride of ammonium, analogous to chloride of potassium, constitutes a definite body,—hydrate of ammonium, analogous to hydrate of potassium, has an inferential existence only. It is inferred to exist in solution from the reactions of the solution; but, under all attempts at extraction, it breaks up into ammonia gas and water, thus:—

$$(H_3N.H)HO \text{ or } H_3N.H_2O = H_3N + H_2O.$$

But by far the most interesting circumstance with regard to ammonia is its property, so remarkably developed by Hofmann, of serving as a type from which compounds of the most varied character are derivable by substitution. Just, for example, as the hydrocarbon residue, or radical, ethyl, C_2H_5, can replace the hydrogen of hydrochloric acid to form ethylic chloride, $C_2H_5.Cl$, so can it also replace the hydrogen of ammonia to form ethylamine, $C_2H_5.H_2N$. This ethylamine constitutes a very volatile liquid, vapourising considerably even at ordinary temperatures. Its vapour closely resembles ammonia gas, but is distinguishable therefrom by its ready inflammability. Like ammonia, ethylamine combines directly with hydrochloric acid to form ethylamine sal-ammoniac, or hydrochloride of ethylamine, $C_2H_5H_2N.HCl$. Like ammonia, also, ethylamine is extremely soluble in water; and its solution, like that of ammonia, behaves in many respects as a definite hydrate, $C_2H_5H_2N.H_2O$, not obtainable, however, in the isolated state, but, like hydrate of ammonia, known only in the state of solution.

There exist, moreover, derivatives of ammonia in which a portion of its hydrogen is replaced, not by a monad, but by a diad residue or radical. Just, for example, as diad ethylene, C_2H_4, replaces the hydrogen of two units of hydrochloric acid to form ethylenic chloride, $C_2H_4.Cl_2$, so can it also replace, in part, the hydrogen of two units of ammonia to form ethylenamine, $C_2H_4(H_2N)_2$ or $(C_2H_4)''H_4N_2$. This double ammonia unites with *two* units of hydrochloric acid to form the definite hydrochloride, $C_2H_4(H_2N)_2.2HCl$, and with *two* units of water to form the equally definite, stable, isolable, volatile, crystallisable hydrate, $C_2H_4(H_2N)_2.2H_2O$.

The hydrochloride and non-isolable hydrate of ethylamine being compared with the chloride and hydrate of the monad alkali-metal potassium, the hydrochloride and isolable hydrate of ethylenamine are similarly comparable with the chloride and hydrate of the diad alkali-metal, barium, thus:—

$$\left.\begin{matrix}K'Cl \\ K'HO\end{matrix}\right\} \left\{ C_2H_5(H_2N)H \right\} \left.\begin{matrix}'Cl \\ 'HO\end{matrix}\right. \qquad \left.\begin{matrix}Ba''Cl_2 \\ Ba''(HO)_2\end{matrix}\right\} \left\{ C_2H_4(H_2N)_2H_2 \right\} \left.\begin{matrix}''Cl_2 \\ ''(HO)_2\end{matrix}\right.$$

And hydrate of ethylenamine agrees with hydrate of barium, as well in being a powerfully alkaline base, as in being de-hydratable, not by the action of heat, but by indirect methods only.

Through the further researches of Hofmann, chemists are acquainted with ammonias and di-ammonias, in which, not only one-third, but two-thirds and three-thirds of the hydrogen are replaced by monad ethyl and diad ethylene respectively. With regard to these compounds, both in their properties and in the nature of the hydrochlorides and hydrates which they furnish, di- and tri-ethylamine correspond very closely to ethylamine; di- and tri-ethylenamine very closely to ethylamine.

	Ethylamines.	Ethylenamines.
Mono- ..	$(C_2H_5)'H_2N$	$(C_2H_4)''H_4N_2$
Di-	$(C_2H_5)'_2HN$	$(C_2H_4)''_2H_2N_2$
Tri-	$(C_2H_5)'_3N$	$(C_2H_4)''_3N_2$

Although, in this way, the principal developments and ultimate establishment of the idea of ammonia as a type have resulted from investigations in organic chemistry, the idea itself appears to have originated, in the first instance, from investigations made in mineral chemistry; and especially from the investigation of compounds formed by the reaction of certain metallic salts and ammonia. Graham, indeed, had early represented certain compounds of metallic chlorides with ammonia as being metallicised sal-ammoniacs; but the notion of ammonia as a trihydric type, susceptible of three successive degrees of substitution, was first enunciated by Laurent, and was employed by that most original chemist to explain, among other matters, the constitution of different ammoniated compounds of platinum, discovered by Magnus, Gros, and Reiset successively. These compounds he represented as being salts of derived ammonias, in which different proportions of the hydrogen of ammonia were replaced by platinum.

Platinum is a moderately hard pewter-coloured metal, possessed of many singular properties. It was first recognised as a distinct metal by Wood, an assayer of Jamaica, in 1741. The mode of working it was discovered and practised by Wollaston early in the present century, and described by him in the *Philosophical Transactions* for 1829. Platinum is especially characterised by its high

* A lecture delivered before the Royal Institution of Great Britain, June 10, 1870.

specific gravity; by its low conductivity, dilatability, and specific heat; by its high ductility and tenacity; by its facile divisibility and reducibility; by its curious absorptivity of certain gases, more especially hydrogen; by its difficult attackability by chemical agents; and by its infusibility at the highest furnace heats. And by each of these several properties, except, perhaps, its high specific gravity, is it suited to some special application in the arts.

Chemically, platinum is characterised by its high atomic weight, 197; and by its formation of two well-defined chlorides,—a perchloride, also known as platinic chloride, expressed by the formula $Pt''''Cl_4$, and a protochloride, also known as platinous chloride, expressed by the formula $Pt''Cl_2$. Platinic chloride occurs in crystalline dark orange masses, freely soluble in water. Platinous chloride forms an olive-brown amorphous powder, quite insoluble in water, but dissolving in hydrochloric acid to form an ochre-coloured liquid. In 1828, the late Professor Magnus, by supersaturating this liquid with ammonia, obtained a remarkable compound, containing the elements of platinous chloride and ammonia, and presenting itself as a dull green, usually crystalline, precipitate. This notable green precipitate has formed the subject of frequent investigation from then till now; and different views of its constitution, from time to time, have been put forward. But no one of these views has received a sufficiently general acceptance to warrant the designation of the compound in accordance therewith; so that, from the period of its discovery down to the present day, it has ever borne the honoured name of its discoverer, and been known as the green salt of Magnus.

Some time after, Gros, in 1838, by treating the salt of Magnus with nitric acid, obtained a peculiar series of pale yellow, or colourless, platin-ammonia compounds. Next in 1840-44 *et seq.*, Reiset and Peyrone, by acting on the salt of Magnus, or on platinous chloride itself, with ammonia, obtained, independently of each other, two additional series of compounds, having relations of metamorphosis both with one another and with the foregoing series of Gros. Then, in 1846, Raewsky, by acting on the salt of Magnus with nitric acid, obtained yet another series of compounds, differing from those furnished to Gros by the same reagent.

But the formulæ attributed by Raewsky to the salts which he had just discovered were inconsistent, both with Laurent's view of ammonia as a type, and with other views of chemical constitution which those illustrious fellow-workers, Laurent and Gerhardt, shared in common. Accordingly, Gerhardt, in 1848, subjected Raewsky's formulæ—notwithstanding their corroboration by a Committee of the Academy—to a most trenchant criticism; and, after supplementing his criticism by laboratory research, published, in 1850, his celebrated memoir "On the Ammoniacal Compounds of Platinum." In this memoir, he established the existence of another, entirely new, series of platin-ammonia compounds; he showed, by experiment, the simple relationship in which the salts of Raewsky stand to the salts of Gros; and he set forth a complete, self-consistent, scheme of viewing the several series of platin-ammonia compounds in their relations to ammonia and to one another.

Since the publication of Gerhardt's memoir, further important contributions to the knowledge of platin-ammonia compounds have been made by different chemists, especially by Buckton, Hadow, and Thomsen. But neither before nor since has any complete general scheme of the constitution of this class of bodies been put forward. Nevertheless, the scheme of Gerhardt, though always treated with respect, has never met with general acceptation, and nowadays, at any rate, is open to very serious objections.*

* Gerhardt's own base platinamine, for instance, is represented by the certainly improbable formula, pt_2HN or $Pt''HN$, and its hydrochloride by the yet more improbable formula, $pt_2HN.2HCl$; in which the unit of a mon-ammonia is represented as combined with two units of hydrochloric acid, and by which the entire chlorine of the salt is represented as fulfilling one and the same function.

The attention of the writer having, of late, been directed to the study of these compounds, he has succeeded in differentiating the simplest of the platinum sal-ammoniacs from several allied and isomeric bodies with which it had before been confounded; and in obtaining from it the corresponding hydrated base of the series. He has also obtained some reactions of interest with bodies belonging to the more complex series; and, as a general result of his inquiries, has ventured to put forward a new scheme of regarding the entire group of bodies. This scheme is based on the recognition of two principal facts or propositions:—

1. The different platin-ammonia compounds are produced, in the first instance, from platinous chloride, $PtCl''_2$; and just as the platinum of this compound possesses the property of taking up two additional proportions of chlorine, so as to furnish the platinic compound, Cl_2PtCl_2, or $Pt''''Cl_4$, so also does the platinum of the different ammoniated bodies obtained from platinous chloride possess the property of taking up two proportions of chlorine, or its equivalent of other negative radical, so as to furnish platinic compounds corresponding to the original platinous compounds respectively. Hence, the division of platin-ammonia compounds into the two classes of platinous and platinic; the compounds of the former, differing in constitution from those of the latter class, just as platinic differs from platinous chloride, by a direct fixation of chlorine.

2. The monad residue, or radical amidogen, H_2N, is capable of becoming the monad radical ammon-amidogen, $H_2N.H_3N$, or H_5N_2, just as the monad radical methyl, H_3C, is capable of becoming the monad radical methylen-methyl or ethyl, $H_3C.H_2C$ or H_5C_2.* Viewing sal-ammoniac, $H_3N.HCl$, as the analogue of methylic chloride, H_2CHCl, the difference is noticeable that, while the ammonia both of sal-ammoniac and ammon-amidogen is easily separable, the methylen both of methylic chloride and methylen-methyl is inseparable from the remaining constituents of the respective compounds. Hence, the distinction between the two classes of amic and ammon-amic platinum compounds, the latter differing from the former by an actual addition of diad ammonia, much as ethylic differ from methylic compounds by a virtual addition of diad methylen. The parallelism is indicated in the under-written formulæ for methylic chloride and ethylic chloride, sal-ammoniac and ammonio-chloride of silver, respectively—

H_2CHCl	$\begin{matrix} H_2C \rbrace H \\ H_2C \rbrace Cl \end{matrix}$	$H_2N.HCl$	$\begin{matrix} H_3N \rbrace Ag \\ H_3N \rbrace Cl \end{matrix}$

The group of platin-ammonia compounds is thus divisible into the two classes of platinous and platinic; and each of these again into the two classes of amic and ammon-amic compounds. To these four classes must yet be added a fifth sub-class of di-platinic compounds, including the nitrate-chloride of Raewsky, and the subsequently-discovered nitrate of Gerhardt and chloride of Hadow. The scheme of the constitution of the entire group, in accordance with the writer's views, is exhibited in the accompanying table of the principal chloride, hydrate, nitrate, and nitrite compounds.

PLATINUM BASES AND SALTS (PROPOSED SCHEME),

Platosamine.

$Pt''(H_2N)_2.2HCl$
$Pt''(H_2N)_2.2H(HO)$
$Pt''(H_2N)_2.2H(NO_3)$

Amo-platosamine (Reiset's).

$Pt''(H_5N_2)_2.2HCl.Aq.$
$Pt''(H_5N_2)_2.2H(HO)$
$Pt''(H_5N_2)_2.2H(NO_3)$

* *Philosophical Magazine*, 1869, p. 459.

Platinamine (Gerhardt's).

$Cl_2Pt''''(H_2N)_2.2HCl$
$Cl_2Pt''''(H_2N)_2.2H(HO)$?
$(HO)_2Pt''''(H_2N)_2.2H(HO)$
$OPt''''(H_2N)_2.2H(NO_3).3Aq$?
$(NO_3)_2Pt''''(H_2N)_2.2H(NO_3)$

Amo-platinamine (Gros's).

$Cl_2Pt''''(H_5N_2)_2.2HCl$
$Cl_2Pt''''(H_5N_2)_2.2H(NO_3)$
$(HO)_2Pt''''(H_5N_2)_2.2H(NO_3)$
$(NO_2)_2Pt''''(H_5N_2)_2.2H(NO_3)$
$(NO_2)_2Pt''''(H_5N_2)_2.2HCl$

Amo-diplatinamine (Raewsky's, &c.).

$Cl_2OPt_2''''(H_5N_2)_4.4HCl.$
$Cl_2OPt_2''''(H_5N_2)_4.4HNO_3.Aq.$
$(NO_3)_2OPt_2''''(H_5N_2)_4.4HNO_3.Aq.$

Platosamine.

The hydrochloride is obtainable by direct action of platinous chloride, $Pt''Cl_2$, on ammonia, just as ethylenamine hydrochloride is obtainable by direct action of ethylenic chloride, $(C_2H_4)''Cl_2$, on ammonia; and, in both reactions, the two compounds are each accompanied by various other products. The parallelism, in constitution and properties, of the two compounds and of their corresponding hydrates is complete—

$Pt''(H_2N)_2.2HCl$	$C_2H_4(H_2N)_2.2HCl$
$Pt''(H_2N)_2.2H_2O$	$C_2H_4(H_2N)_2.2H_2O$

Hydrochloride of platosamine, in its pure state, has a dull, very pale, primrose colour, approaching almost to white. It is very insoluble in cold, considerably more soluble in hot water.* From its concentrated hot solution it is usually deposited as a flocculent-looking, though really crystalline, or partly crystalline, precipitate; and by slow cooling of the solution, it may be obtained wholly in the form of distinct needles. The base is obtained from the hydrochloride, through the intervention of the sulphate, by decomposing the latter with baryta water. It is extremely soluble in water, and readily crystallisable. It furnishes a solution manifesting a strongly alkaline reaction, liberating ammonia from its salts, neutralising acids, absorbing carbonic acid from the air, and decomposing metallic salts—the precipitates thrown down being, however, for the most part double compounds.

The base and other soluble platosamine compounds are characterised by giving with hydrochloric acid a precipitate of the hydrochloride, which, when formed in this way, is almost always yellow and crystalline. All platosamine compounds, including the hydrochloride, exhibit the platinous property of absorbing chlorine, and hence of decolourising a mixture of hydrochloric acid and permanganate, to yield platinamine compounds; and they all, including the hydrochloride, dissolve in gently-heated ammonia, to yield their corresponding amo-platosamine compounds.

Amo-platosamine.

The hydrochloride of this series, unlike that of the preceding, is freely soluble in water. It is a beautiful salt, crystallising usually in a mass of interlaced lengthy needles. It is made by dissolving platinous chloride, salt of Magnus, or the above platosamine hydrochloride, in aqueous ammonia at a gentle heat. The hydrated base is obtained from it, as is the preceding hydrated base from the preceding hydrochloride. The so-produced hydrate corresponds in its general properties with the above hydrate of platosamine, than which, however, it is far more powerfully alkaline. From different metallic salts it throws down the respective metallic hydrates.

Amo-platosamine salts, like those of platosamine, exhibit the platinous property of decolourising a mixture of hydrochloric acid and permanganate, of directly absorbing chlorine or bromine, and also of directly absorbing nitric peroxide, to furnish amo-platinic compounds.* The resulting amo-platinic chloro-chloride occurs as a pale yellow, the nitro-chloride as a pale green, and the nitro-nitrate as a pale blue precipitate. Amo-platosamine is further distinguished from platosamine by the free solubility of its hydrochloride, and by the reaction of this salt with platinous chloride solution to throw down the green salt of Magnus.

Platinic Compounds.

The most characteristic of the salts of platinamine is the chloride $Cl_2Pt''''(H_2N)_2.2HCl$. It is best made by addition of permanganate, in very slight excess, to a hot solution of platosamine hydrochloride, acidified with hydrochloric acid. It is a beautiful bright yellow salt, dissolving sparingly in cold, moderately, though, on account of its density, somewhat slowly, in boiling water; and crystallising readily on cooling in isolated octohedrons or square plates. It reacts with excess of ammonia, at a gentle heat, to form the insoluble chloride of amo-platinamine. Its chlorine, like that of the amo-platinic chloride, is evidently in two different conditions of attackability by reagents, such as alkalies and silver salts. The hydrate of platinamine is obtained from the hydrate-nitrate, by means of ammonia, as a neutral, almost insoluble, bright yellow, crystalline precipitate.

The best known salt of amo-platinamine is the chloro-nitrate, $Cl_2Pt''''(N_2H_5)_2.2HNO_3$, obtained by treating the salt of Magnus, or preferably the hydrochloride of amo-platosamine, with nitric acid. It is moderately soluble in water, and crystallises therefrom in brilliant white flat prisms. Its chlorine is not immediately recognisable by nitrate of silver; and is only partially precipitable thereby, even after long boiling. Its solution yields, with ammonium chloride and sodium sulphate, crystalline white precipitates of the chloro-chloride and chloro-sulphate respectively.

The most familiar salt of amo-diplatinamine is the chloroxy-nitrate, $Cl_2OPt_2''''(H_5N_2)_4.4HNO_3.Aq$. It is best made by boiling the chloro-nitrate or chloro-chloride of amo-platinamine with nitric acid and nitrate of silver. It presents considerable resemblance to the chloro-nitrate of amo-platinamine, but its solution is not disturbed either by sulphate of sodium or chloride of ammonium. It yields, moreover, with platinous chloride solution, a moss-like coppery precipitate which is highly characteristic (Hadow).

* The orange-yellow, scaly, far more soluble hydrochloride, obtained by dissolving salt of Magnus in sulphate of ammonia solution, is a distinct compound.

* The reaction of amo-platosamine compounds with nitric peroxide was discovered by Hadow, but received from him a different interpretation.

NOTE ON THE TEMPERATURE AND HEATING-POWERS OF FLAMES.†

By W. M. WATTS, D.Sc.

MR. WATTS has forwarded to us the following remarks on Messrs. Silliman and Wurtz's paper "On the Temperatures of Flames," which appeared in our last and previous numbers, in which certain conclusions on some practical points of importance are stated.

The following numbers are correctly given as representing the amounts of heat evolved by the complete combustion of equal volumes of the following gases:—

Hydrogen	34462
Carbonic oxide	33642
Marsh gas	104504
Olefiant gas	166012

† From the *Philosophical Magazine*, May, 1870.

But the conclusion that the heating-power of olefiant gas is greater than that of an equal volume of hydrogen is condemned as erroneous; and the authors give, as the result of their investigations, "that the powers of the flames of pure hydrogen and pure olefiant gas, even when used to the greatest advantage, to heat water below its boiling-point are almost or quite identical."

There seems to be, throughout the paper, a confusion between the *heating-power* of a gas and the *temperature of its flame* in air.

It is quite true that, because the specific heat of steam (which is one of the products of combustion of olefiant gas) is greater than the specific heat of carbonic anhydride (the only product of combustion of carbonic oxide), the calculated flame-temperature of the latter gas is higher than that of the former; but, for the very same reason, if these gaseous products of combustion expend their heat in raising the temperature of water, the greatest effect will be produced by the olefiant gas, although the temperature of its flame is not so high as that of the flame of carbonic oxide. If the gases give up the whole of their heat to the water, it is obvious that the calorific effects must be precisely in the ratio of the numbers already quoted; and, even if they escape at a temperature considerably above 0° C., their relative effects will be nearly the same. If we suppose the products of combustion to have a temperature of 200° C. when they escape, the following quantities of heat will still be available by the combustion of equal volumes of carbonic oxide and olefiant gas:—

Gas burnt..	Lbs. of water raised from 0° C. to 100° C.
14 lbs. carbonic oxide	314
14 lbs. olefiant gas	1546

And these numbers are almost exactly in the same ratio as the numbers 33642 and 166012. We conclude, therefore, that the numbers quoted (vol. xxi., p. 282), in which, according to Messrs. Silliman and Wurtz, "several most grave errors are involved," do, in reality, strictly represent the heating-effects of the different gases when employed the greatest advantage, in heating water below 100° C.

The omission of the correction for the latent heat of steam in Bunsen's original calculation of the temperature of the hydrogen-flame has been already pointed out by Dibbits.*

In the calculation of the temperature of the hydrogen-flame given in this paper (p. 283), there is also an error in assigning to liquid water the specific heat 0·4805, instead of 1. The formula should be—

$$x = \frac{34462 - 9(637 - 48{\cdot}05)}{4{\cdot}3245} = 6743^{\circ}\ \text{C.}$$

Another of the conclusions arrived at in this paper is erroneous, viz., "That, of all known gases, the highest calorific effects,† under ordinary atmospheric conditions, are obtainable from *carbonic oxide*, whose calorific value, above 100° C., is about 3000° C."

The flame of cyanogen is hotter than that of carbonic oxide, the calculated temperature of the flame of cyanogen in air being 3519° C., and in oxygen no less than 10557° C. It must be remembered, however, that these results of calculation in no way express the actual flame-temperatures. The calculated temperature of the oxy-hydrogen-flame is 6743° C.; but the experiments of Deville‡ and Bunsen‖ agree in fixing between 2500° C. and 2800° C. The following are the calculated and experimental flame-temperatures of certain gases; it will be seen that the flame of cyanogen is shown by experiment also to have the highest temperature:—

	Calculated. °C.	Experimental. °C.
Hydrogen in air	2701 ..	2024
,, ,, oxygen ..	6743 ..	2844
Carbonic oxide in air ..	2996 ..	1997
,, ,, oxygen	7067 ..	3033
Cyanogen in air	3519 ..	3297
,, ,, oxygen ..	10557 ..	—
Olefiant gas in air	2727 ..	—
,, ,, oxygen ..	8606 ..	—

* *Pogg. Ann.*, vol. cxxii., p. 497.
† Read "flame-temperatures."
‡ *Leçons sur la Dissociation*, p. 281.
‖ *Pogg. Ann.*, vol. cxxxi., p. 161.

ON THE DESCENT OF GLACIERS.*

By The Rev. HENRY MOSELEY, M.A., F.R.S., Canon of Bristol, and Instit. Imp. Sci. Paris Corresp.

(Concluded from p. 278.)

All Alpine travellers, from De Saussure to Forbes and Tyndall, have borne testimony to the intensity of the solar radiation on the surfaces of glaciers. "I scarcely ever," says Forbes, "remember to have found the sun more piercing that at the Jardin." This heat passes abruptly into a state of intense cold when any part of the glacier falls into shadow by an alteration of the position of the sun, or even by the passing over it of a cloud. Now the Mer de Glace moves faster by day than by night. Its mean daily motion is twice as great during the six summer as during the six winter months. The connection between its rate of motion and the external temperature is most remarkable. It has been carefully observed, and the results as recorded by Professor Forbes leave no doubt of the fact, that no change of external mean temperature is unaccompanied by a corresponding change of glacier motion. From this it follows that the two are either dependent on some common cause, or that the one set of changes stands in the relation of a cause to the other. That both sets of phenomena—the changes of the sun's heat, and the changes of glacier motion—should be due to some common independent cause, seems impossible. We are forced, therefore, on the conclusion that one is caused by the other. And as the changes in the glacier motion cannot cause the changes of solar heat, it must be the changes of solar heat which cause the changes of glacier motion. The *sun* is obviously *master* of the glacier. Nor is this to be considered a startling or improbable conclusion. Heat is but another form of mechanical power. This power is constantly streaming into the glacier; for ice is dia-thermanous. It is readily penetrable by luminous heat. This has been shown by Tyndall, who, having sent a beam of heat through a block of Wenham Lake ice, saw its course starred by the dilatations of the ice. I have, moreover, myself obtained an ice lens by causing ice to be turned in a lathe to a spherical surface by means of a templet of iron. Through this lens the rays of the sun streamed in abundance, and were concentrated in its focus with such intensity as to burn the hand and instantly set fire to a match. There can be no doubt, therefore, that the rays of the sun, which in those Alpine regions are of such remarkable intensity, find their way into the depths of the glacier. They are a *power*, and there is no such thing as the loss of power. The mechanical "work" which is their equivalent, and into which they are converted when received into the substance of a solid body, accumulates and stores itself up in the ice under the form of what we call elastic force, or tendency to dilate, until it becomes sufficient to produce actual dilatation of the ice in the direction in which the resistance is weakest, and by its withdrawal to produce contraction. How much heat entering the surface of a glacier is necessary to this result has been made the subject of calculation. Supposing the depth of the ice to

* Read before the Royal Institution of Great Britain, May 13, 1870.

be the same as that at the Tacul, its motion at different depths that which Tyndall found it to be there, and its surface motion that which he measured lower on the Mer de Glace at Les Ponts, and supposing the resistance to shearing of ice to be 75 lbs. per square inch; then the mechanical work, which acting within the mass is necessary to put the glacier in motion, as it actually moves, is 61¾ units of work per square inch of the surface of the glacier per day.* Now this quantity of work would be supplied by 0·0635 heat-unit entering the ice per square inch of surface per day and diffusing itself through it, each heat-unit being the heat necessary to raise 1 lb. water by 1° F. Far more than this heat probably passes the surface and enters into the ice of a glacier on days such as that when the motion was observed which serves as the basis of these calculations.

But *how* does this mechanical power, which thus streams continually into a glacier when the sun shines on it, compel its descent?

The fact of the descent of a sheet of lead when placed upon the inclined surface of a roof, however low the pitch, especially in summer, has long been known; I myself first observed it on the southern side of the roof of the Choir of the Bristol Cathedral, in 1855. I have verified it by the following experiment:—I fixed a deal board 9 feet long and 5 inches broad to the southern wall of my house, so as to form an inclined plane, and upon it I placed a sheet of lead, turning its edges down over the side edges of the board, and taking care that it should not bind upon them, but be free to move with no other obstruction than that which arose from its friction. The inclination of the board was 18° 32′, the thickness of the lead ¼th of an inch, its length 9 feet, and its weight 28 lbs. The lower end of the board was brought opposite to a window, and a vernier was constructed, which could be read from within, and by which the position of the lead upon the board could be observed to the 100th of an inch. I began to measure the descent of the lead on the 16th of February, 1858, and recorded it every morning between seven and eight o'clock, and every evening between six and seven o'clock, until the 28th of June. I have preserved all these observations. In the night, between sunset and sunrise, the lead scarcely descended at all. It was on days when the thermometer in the sun varied its height rapidly and much—as on bright days with cold winds, or when clouds were driven over the sun—that the descent was greatest. So remarkable, indeed, was this the case, that every cloud which shut off the sun for a time from the lead, and every gust of wind which blew upon it in the sunshine, seemed to bring it down a step. On such days it would descend from ¼ to ½ an inch. On the contrary, when the sky was open and clear, and the heat advanced and receded uniformly, the descent was less, although the difference of the extreme temperatures of day and night might be greater. It was least of all on days of continuous rain. The sun was the obvious cause of the descent of the lead. It was master of the lead, as it is of the glacier. A dilatation and contraction of it was caused by the passage into it, and the withdrawal, of the sun's radiant heat, and this dilatation and contraction of the lead caused it to descend. Why it should do so may be easily explained.

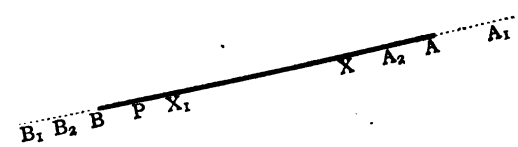
Let A B, Fig. 1, be an elementary plate of the solid, and conceive it to be divided into an infinite number of equal elements by planes perpendicular to its length. Let x be a point so taken in it that, if it were divided in x, the thrust necessary to push the part x A up the plane would equal that necessary to push x B down it. Let an element at x be imagined to have its temperature so raised as just to equal this thrust; and let the temperatures of all the elements in x A, beginning at x, be equally raised in succession. Each will thus be dilated more than the one before it, because its dilatation will be opposed by a less resistance; and the displacement, A A_1, of the extremity upwards will equal the sum of these several dilitations. In like manner,

if the same temperature be added to the elements of x B in succession, beginning from x, each will be dilated more than the one before it, and the displacement, B B_1, of the extremity B downwards will equal the sum of these several dilatations. The point x will obviously be nearer to A than to B, because the same thrust of dilatation of the element at x would not be able to push so great a length of the bar up the plane as it would down it.

In this state of the temperature of the plate, let a point, x_1, be taken such that, if it were divided there, the strain necessary to pull the part x_1 A_1 down the plane would just equal that necessary to pull x_1 B_1 up it. Let the temperature of the element at x_1 be so diminished as by its contraction just to produce this strain, and let the temperatures of all the elements from x_1 A_1 in suecession be similarly reduced. Each will contract more than the one before it, because a less resistance will be offered to its contraction; and the displacement A_1 A_2 of A_1 down the plane will equal the sum of these separate contractions. In the same way the displacement B_1 B_2 of B_1 up the plane will equal the sum of the separate contractions of the elements of x_1 B_1. The point x_1 will be farther from A_1 than B_1, because the same strain of contraction of an element at x_1 would pull a greater length of the bar down the plane than up it.

It is by the dilatation of the greater length of the plate x B favoured by its weight that the extremity B is

FIG. 1.



displaced down the plane when the temperature is raised; whilst it is by the contraction of the less length, x_1 B_1, against its weight that it is displaced up the plane when the temperature is lowered. The extremity B is, therefore, more displaced down the plane by a given raising of the temperature than it is displaced up it by a corresponding lowering. On the whole, therefore, the extremity B is made to *descend* the plane to B_2 by a given alternation of temperature. It is by the dilatation of the less length, x A, that the extremity A is displaced up the plane, and by the contraction of the greater length, x_1 A_1, that it is displaced down the plane. It is, therefore, less displaced up by dilatation, than it is down by contraction, and on the whole it descends to A_2 by a given alternation of temperature. Both the extremities A and B of the plate are, therefore, made to descend when it is subjected to a given elevation and then to a corresponding depression of its temperature; that is, the *whole* plate is made to *descend* from A B to A_2 B_2.

Now, the theory of the descent of glaciers, which I have ventured to propose, is that they descend, as the lead in this experiment does, by reason of the passage into them and the withdrawal of the sun's rays, and that the dilatation and contraction of the ice so produced is the proximate cause.

There is no substance the dilatation or contraction of which, by changes of temperature, is more thoroughly and accurately known than that of ice. Experiments were made upon it by three independent observers, at the observatory of Pultowa, in the winters of 1845 and 1846, between the temperatures of 0·9 R. and 28·82 R., from which it resulted that ice is by far the most dilatable of all known solid substances, being nearly twice as dilatable as lead. These experiments have been described by Baron W. Struve, in the "*Transactions of the Academy of St Petersburg.*

The ice of a glacier behaves itself in its descent ex as the lead did in my experiment.

* *Proceedings of the Royal Society*, January, 1860, p. 207.

It has been argued in opposition to this theory that the temperature of the ice of glaciers is, by the observations of Agassiz, but very little below 32°, and that if radiant heat found its way into it, it would not expand, but melt it. To this there is the obvious answer that radiant heat does find its way into ice as a matter of common observation, and that it does not melt it, except at its surface, and therefore that it *does* dilate it. Blocks of ice may be seen in the windows of ice shops with the sun shining full upon them, and melting nowhere but on their surfaces And the experiment of the ice-lens shows that heat may stream through ice in abundance—of which a portion is necessarily stopped in the passage—without melting it, except on its surface. My theory supposes that the ice beneath the surface of a glacier is a *solid*. That is all.

Being a solid, and receiving into its substance heat—that work—in great quantities, that work (by the principle of the conservation of force) cannot but be stored up in it, under the form of "potential energy," and wherever it is present, produce a tendency to dilatation. When that tendency takes effect, it is in the direction of the least resistance to the dilatation of that part. It matters not whether the temperature of the ice be below 32° or above it, provided only that the condition of solidity be satisfied. Being a solid, it cannot but dilate and contract under the variations of temperature to which it is subjected; and dilating and contracting, it cannot but descend. To show that the ice of a glacier does not dilate when heat is received into it, it would be necessary to show it not to be subject in this respect to a law common to all other solid bodies.

Great alternations of temperature are not necessary to cause the motion of a glacier. A succession of *small* alternations produces the same effect as one great one. Their effect is cumulative. Alternations backwards and forwards, of 2° each, six times repeated, would carry the glacier (under certain assumed conditions) as far down as a single alternation of 12°.

The observations of Agassiz on the temperature of the ice of the Aar glacier in 1841-1842, were made in borings from 15 to 200 feet deep. Thermometers placed in these borings never fell below 0·3 C., although the external temperature descended at night to 5° or 6° C. Commonly they showed exactly zero.* Nothing can, however, be concluded from these experiments, because the thermometers were not *frozen into the ice* of the glacier, or the mouths of the borings so effectually stopped as to prevent the access of air or the percolation of water from the disintegrated ice near the surface. The maintenance of a constant state of humidity in the air of the boring not being thus provided against, the included thermometer could not but remain at zero, however low might be the temperature of the surrounding ice. For the water of the contained air freezing on the sides of the boring (like hoar frost) would raise the temperature around the bulb, by the latent heat set free in freezing, to zero, C. And the humidity of the air being continually renewed, this process would always go on.

"A thermometer is, in short, incapable of taking the temperature of ice, unless that ice be dry."† These are the words of that eminent man Principal Forbes in the last (I think) of his papers on the subject of glaciers.

On a Friday evening like *this*, eight years ago, another eminent man, whose loss to science we all deplore, addressed the audience then assembled here on the subject on which I have now been addressing you. He possessed every accomplishment for the investigation of it, and had studied it long and successfully; he was versed in physics, and was an able and original mathematician. I speak of Mr. William Hopkins, whose name will always be held in honour by reason of his many contributions to the science of glaciers, and especially because of the explanation he first gave of the formation of crevasses. In the introductory part of the discourse which Mr. Hopkins then delivered he "insisted on the necessity of a more exact definition of terms and more accurate modes of mathematical reasoning than those which had up to that time characterised the discussion of glacial phenomena."

That, on the necessity of which he insisted and for which he laboured, I also have laboured for. I have sought to bring the discussion of glacial phenomena out of the wide region of scientific opinion, and place it in that of exact science. That work is, however, still far from being completed. Life, too, is short, and the power to pursue studies such as these is sometimes shorter in duration than life itself. But other workers are behind.

* *Bulletin de Genève*, tom. 44, p. 349.
† Forbes, *Phil. Mag.*, March, 1859.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 16th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—L. A. Lucas and A. W. Bickerton.

Mr. JAMES BELL read a paper "*On Fermentation.*"

A series of experiments has been instituted, and is still in progress, to determine the forms of natural ferment which albumen, derived from different sources and under various conditions, will give rise to.

Albumen of egg was introduced into a cane-sugar solution, and the mixture allowed to ferment at a temperature of 75° F. Fungoid cells, different from those of yeast, were formed, and possessed of very little fermentative power, inasmuch as only 0·2 per cent of alcohol were produced in this sample.

Albumen of flour and malt, in a cane-sugar solution, gave rise to the development of a fungoid mycilium, and consequent production of cells and spores similar to those obtained by albumen of egg. These, too, were of very limited fermentative power. The albumen in this case was prepared by coagulation, and then by precipitation. When albumen of the first kind was brought into the sugar solution, the liquid very soon contained parasites, and became rapidly acid. If albumen obtained by precipitation with alcohol was employed, the solution, even after a week, was free from parasites, and also of acidity.

Cold water extracts of flour and malt were added to cane-sugar solution, which also contained some glucose. The extract, on addition of cane-sugar, was converted into mucilage; and the change is permanent in flour-extracts, but extracts of barley-meal possess great power to produce the yeast-cells, which act upon the mucilage, and resolve a portion of it into alcohol and carbonic acid. The development of the yeast-cells in the mucilage is a most interesting sight: the cells, as they multiply, are prevented from separating, on account of the thickness of the solution, and thus remain clustered together.

Cold water extracts of grain abound with microscopic parasites, which soon set up a strong action, thereby giving rise to the production of acid, and doubtless, also, to the transformation of the cane-sugar into mucilage. Boiling destroys these parasites, prevents in a great measure the production of acid, and subsequently yields more alcohol. This conclusion was arrived at after many and varied experiments.

When "pus" was employed as ferment, a fungoid organism, similar to that obtained by albumen from flour and malt, was developed in the solution, which likewise possessed very little fermentative power.

The fermentative properties of two moulds, the blue mould from moist malt and the mould from lemon-juice, were next investigated in a glucose solution. Both proved good ferments.

In order to compare the relative fermentative power of the yeast-plants of malt and the grape, the following experiments were instituted:—

To a solution capable of giving 16 per cent alcohol, brewers' pressed yeast was added successively. The limit was reached on the sixteenth day; but the experiment was carried on for upwards of thirty days, when the alcohol in the liquid amounted to 15·91 per cent. When the extreme point was reached, the yeast-cells became contracted and shrivelled; but, when they were transferred to a fresh sugar-solution, they recovered their vitality. In several cases, glucose was added to the cane-sugar solution; and it was here observed that, in the presence of an excess of glucose, comparatively less alcohol was obtained: the alcohol and glucose combined seem to act as an antiseptic.

To the must from English hot-house grapes a known quantity of glucose was added, and the liquid, together with the greater part of the husks, was left to ferment at 65° F. The fermentation ceased in about twenty-three days. Another sample was permitted to ferment at 75° F.; and here all action ceased on the sixteenth day. To a third sample such amount of glucose was added as to bring the glucose naturally existing in the juice up to 40 per cent. In this case, the beginning of the fermentation was delayed much beyond the usual time; and the quantity of alcohol obtained was less than in a case where less glucose had been added.

In all cases the wine-ferment proved to be of greater fermentative power than the malt-ferment.

From all these experiments Mr. Bell deduces the conclusion that it would be advantageous to add to grape-juice some glucose, so as to assist the exhaustion of the must of its fermentative element, and to impart thus to the wine a greater keeping-power. In some instances the fermentation was started in the grape-juice by brewers' yeast: the amount of alcohol here obtained was less than in the cases where the action was caused by the natural ferment of the grape-juice.

Finally, Mr. Bell instituted some experiments to ascertain the influence of change of soil; and the results in connection with the observations made in some of the above experiments lead to the inference that the various ferments have their favourite soils.

The PRESIDENT, in asking the Fellows to vote their thanks to the author, gave a brief *resumé* of the state of knowledge we at the present day possess of the yeast-plant. Though called a "plant," the yeast organism appears in all its functions rather animal than vegetable. The products of its secretion are less complicated than those it takes in. It does not, like plants, require light for its vital process; neither does it absorb heat, but, on the contrary, gives such off. Prof. Williamson then, alluding to Leibig's recent memoir, observed that this distinguished chemist has entirely dropped his ancient notions regarding fermentation, though he somewhat successfully criticised some of Pasteur's statements.

The next paper read was, "*On Organic Matter in Water*," by Dr. HEISCH.

The author was, some time ago, called on to assist a large manufacturer of lemonade, who suddenly found it impossible to make lemonade that would keep; after a day or two it became turbid, and its odour anything but agreeable. On examining the liquid under the microscope, it was found full of small spherical cells, with, in most cases, a very bright nucleus.

After investigating all the materials employed, the water was detected to bear the fault. On putting a few grains of the purest crystalline sugar into some of the water, it became turbid in a few hours, and contained the cells previously described.

On enquiry, Dr. Heisch found that some digging had been going on in the neighbourhood of the well from which the water came; and that, through this circumstance, some drainage must have got into the well. This led the experimenter to try various samples of waters in the same manner; and, in every case where diarrhœa or other mischief could be traced to the use of a certain water, when that water was treated with sugar, the same cells made their appearance usually within 24 hours, if kept at 60° to 70°, and plenty of light was admitted to the bottle containing the fermenting liquid.

Believing sewage to be the source of these cellular germs, Dr. Heisch mixed a minute quantity of sewage with a sugar-solution which had been previously ascertained to be free of cells, and found the solution very soon to contain those germs. A number of experiments were made to find out whether other substances than sewage or sewage-water were capable of producing organisms of similar kind when placed into a sugar-solution; but, though in a few cases some growths were produced, they never resembled the cells originated by sewage. In all the experiments with sewage, where the particular cells made their appearance, a butyric odour also was perceptible. Filtering the water through the finest Swedish paper does not remove the germs. Boiling for half an hour in no way destroys their vitality. Filtration through a good bed of animal charcoal seems to be the only effectual mode of removing them; but it is necessary to air the charcoal from time to time, else it loses its purifying power.

The author is at present engaged to ascertain what substances are capable of retarding or preventing the development of these germs. As to the conclusions derived from the above observations, Dr. Heisch thinks that wherever the described germs occur in water they are distinct evidence of sewage-contamination.

Mr. PERKIN read a letter from Prof. Strecker, wherein he claims the priority of having published the true formula of alizarine as early as 1866, a priority which had been ignored by Mr. Perkin in his recent lecture on alizarine. Mr. Perkin said that this omission is due only to a slight oversight; he never intended to deprive Prof. Strecker of his merits.

Mr. W. D. HERMAN communicated a paper "*On the Methods for the Determination of Carbon in Steel.*"

The author, whilst studying the process for determining carbon in steel known as Eggertz's Colorimetric Method, observed certain irregularities and imperfections in its practical working. One of the most serious difficulties in this process, arising from the instability of the standard solution of burnt sugar, had been overcome for some time past by Mr. Valentin, who employed, with perfect success, a solution of sulphindigotic acid which had undergone decomposition by exposure to sunlight. Although much was gained by substituting a stable for an unstable solution, it was still apparent that the colour of the solution of various samples of steel in nitric acid, especially of those containing larger quantities of carbon, did not always coincide in tint with the new colour-standard.

These difficulties led the author to corroborate the colorimetric results by other methods of analysis. He first tried Elliott's method (described in the new edition of Fresenius's "Quantitative Analysis"); but the washing of the carbon on the asbestos filter was found to be too tedious, and the whole process requiring great care and constant attention. A direct method of analysis was therefore tried, and the iron burnt in a stream of oxygen. The heat produced by this process was, however, so great that the best glass tubes cracked on cooling. This obstacle was surmounted by using a platinum tube, which is connected with the glass apparatus containing the soda-lime, &c., by means of a brass tube tinned inside, and the latter is joined to the platinum tube by means of a bayonet-joint. The steel to be analysed is previously softened, and then reduced to fine filings, by means of a *single-cut* file, which has the advantage of bringing to a minimum the danger of breaking off the teeth, and also of producing filings in fine shreds, a condition very favourable to rapid and complete oxidation. The time required for the oxidation of about 2 grms. of steel was usually forty minutes. The amount of ferric oxide left

behind after the combustion of the carbon may be weighed, and its weight, coinciding with the amount required by theory, serves then as a criterion of the completeness of the combustion.

The following table contains a *resumé* of the means of the results obtained by the different methods employed by Mr. Herman for determining the carbon in various samples of steel:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
By Eggertz's colorimetric method	1·3190	0·7890	0·7010	0·5870	0·4860	0·3490	0·2830	—
By direct combustion of filings in oxygen	1·1656	0·7602	0·6350	—	—	0·3594	0·2730	0·9215
By Elliott's methods ..	1·2480	0·8065	0·7240	0·6701	0·5025	0·4772	0·3490	0·9427

From all the foregoing observations it follows:—

1. That Eggertz's process cannot be employed when the amount of carbon is large, and is required to be known with accuracy.

2. That the method of combustion in oxygen is preferable as being direct, expeditious, giving accurate results, and allowing to ascertain readily whether the combustion has been a complete one.

In conclusion, the author expressed his thanks to Mr. Valentin for the valuable advice received whilst conducting these experiments.

ROYAL IRISH ACADEMY.

AT a meeting held on Monday, June 13th, at the Academy House, the Rev. Prof. JELLETT in the chair, Dr. SIGERSON read a paper on the "*Microscopic Appearances obtained from Special Atmospheres.*

His lecture was illustrated with large diagrams representing some of the objects discovered. In "iron-factory air" he found carbon, ash, and iron: the iron was discovered to be hollow balls, averaging 1-2000th part of an inch in diameter, their shells being only 1-30,000th part of an inch; and the iron was found to be translucid. In "shirt-factory air" there were filaments and fragments of linen and cotton, with minute eggs. The air of threshing and oat mills had fibres, fragments, starch-grains, and spores. "Scutch-mills," from the character and the spongy, spiky dust and its effects, he declared to be human slaughter-houses: by a suggested alteration, the workers could be kept free of the dust, and many lives saved. In the air of the printing-offices antimony was expected, and Dr. Sullivan's analysis confirmed the expectation: it is probably present to an injurious extent in type-foundries. Stable air was shown to contain cuticle-scales and hair; and hairdressers' establishments had a similar atmosphere. Some appalling revelations of the contents of dissecting-room air were made. Smoke being microscopically examined, the tobacco-smoker's air was shown to contain globules of nicotine, a poison. The air inhaled by tea-tasters was discovered to contain tea, sprinkled with fibres, tissue, and drops of a powerful narcotic oil.

He concluded by stating his conclusions arrived at with regard to lung-functions and contagion.

CORRESPONDENCE.

TETRABROMIDE OF CARBON.

To the Editor of the Chemical News.

SIR,—I am very sorry to trespass again upon your valuable space, but a letter from "The Reporter" in the CHEMICAL NEWS (vol. xxi., p. 273), seems to call for some remark.

In our paper communicated to the Chemical Society on May 5th, the following passage occurs "The bromination of the bisulphide may, however, be effected by two different methods: by submitting it to *the action of bromine in the presence* either of bromide of iodine or of antimony terbromide." Any chemist can perceive the great difference between this and the official Reporter's account published in the CHEMICAL NEWS (vol. xxi., p. 223).—I am, &c.,

CHARLES E. GROVES.

17, Rodney Street, Pentonville.

[The report should have read:—"This combination is obtained—1. by heating bisulphide of carbon with *bromine* and bromide of iodine &c." The omission of the word "bromine" was an oversight.—*Ed. C.N.*]

LIEBIG'S EXTRACT—BOILING WATER.

To the Editor of the Chemical News.

SIR,—I forward some observations on Liebig's extract, derived from my own experience on a walking journey; also the results of my experiments on boiling water with the minimum of fuel.—I am, &c.,

W. T. SUFFOLK.

I became acquainted with Liebig's extract of meat during an illness last summer, when it was prescribed as an article of diet. I had been suffering from indigestion, and could not help noticing the ease with which it was assimilated and its speedy restorative action. Having experienced so great benefit from its use, I resolved to give it a trial during a long pedestrian excursion, and endeavour to test its value as food.

The action of the extract is very marked when used as a remedy for the exhaustion so frequently attending long and fatiguing walks, closely resembling in its effect the well-known restorative, tea and brandy, but it is much more permanent, acting not only as a stimulant, but also as nutritive matter.

The extract cannot well be used by itself as a substitute for ordinary food, but when accompanied by a quantity of less nutritious and digestible matter greatly augments its dietetic value. With Liebig's extract, bread or biscuit, and, if possible, hard-boiled eggs, the pedestrian will be provided for nearly every emergency. For the sake of variety of flavour, pepper, salt, curry powder, or other condiments may be used.

I prefer, when possible, to use the extract in the usual way—dissolved in hot water as soup,—but where hot water cannot be procured, it may be thinly spread upon bread or biscuit and eaten with equal effect. In either way it gives strength almost immediately, and stands very much in the same relation to ordinary food that petroleum does to coal as a steam-producing fuel, enabling power to be speedily obtained.

It must, however, be borne in mind that stimulating food can only be employed as an auxiliary, and not as a substitute for proper rest, the only true restorative. In long pedestrian journeys everything depends upon intervals of rest and proper food, if the exertion is to be continued for many days in succession.

Spirit of any kind should always be used cautiously; as its stimulating power is at the best of short duration nothing is added to actual bodily strength. It is sometimes of value in cases of difficult breathing, caused by steep ascents, a teaspoonful of strong brandy or whisky generally giving instant relief; also in the nervous giddiness which occasionally affects travellers, especially solitary ones, when walking on narrow elevated paths. This may seem somewhat like acquiring "Dutch courage," but nevertheless the discreet use of spirit in such cases is not to be undervalued.

For the purpose of boiling water *en route*, I employ an "Etna" of French construction, made of very thin copper, electro-plated, and weighing, with a store of 6 ozs. of spirit, 1¼ lbs.

The time occupied in boiling half a pint of water is

from seven to ten minutes, and the consumption of spirit about two fluid drachms. The apparatus requires a perfectly calm atmosphere for its proper action; this may be secured by building a small cromlech of flat stones, which are always at hand in hilly countries, and with the help of a large handkerchief as a further protection against the wind, no difficulty will be found in securing efficient performance; other contrivances will suggest themselves where stones are not procurable.

Although it would seem that alcohol is consumed to a disadvantage without a wick, yet practically the "Etna" boils water with a smaller consumption of spirit than any contrivance I have yet tried. My best lamp, an argand, requiring at least half an ounce to do the same work as the Etna. The Russian blast lamp is still more wasteful, consuming nearly 2 ounces.

I attribute the superior economy of the Etna to the low temperature of the wickless flame and the manner in which the boiler is wrapped in the fire, no more heat being supplied than can be taken up by so bad a conductor as water. The defect of all lamps giving an intense flame being that heat is wasted by being supplied too quickly, so that the apparently feeble fire in the gutter of the Etna is more efficient than the heat of powerful lamps, as well as more economical; the latter quality is very important to the pedestrian, to whom every ounce of weight is a consideration.

OZONE AND SULPHUROUS ACID.

To the Editor of the Chemical News.

SIR,—I am not aware that the resemblance between these substances has been noticed, though, that O_3 and SO_2 are molecules containing the same number of like atoms similarly condensed, must be readily apparent, as also that the series

$$TeO_2 \quad SeO_2 \quad SO_2$$

might be continued to include OO_2, just as naturally as the series

$$TeH_2 \quad SeH_2 \quad SH_2$$

includes as its last term OH_2.

That the argument may not, however, rest solely upon considerations of atoms, volumes, and family analogies, which might be deemed by some persons fanciful and inconclusive, I rapidly parallel a few physical or chemical correspondences:—

OO_2.	SO_2.
A (1). Odorous, dense, colourless gas.	B (1). Pungent, dense, colourless gas.
A (2). Bleaches, disinfects, deodorises.	B (2). Bleaches, disinfects, deodorises.
A (3). Tarnishes moist metals, *e.g.*, Fe.	B (3). Corrodes moist metals, *e.g.*, Fe.
A (4). Absorbed totally by turps.	B (4). Absorbed partially by turps.
A (5). Whitens lead-paper previously blackened by H_2S.	B (5). Whitens lead-paper previously blackened by H_2S.
A (6). Absorbed by solution of KI, rendering latter yellow by disengagement of free I.	B (6). Absorbed by solution of KI, rendering latter yellow.
A (7). Antozone (its complementary molecule), according to M. Soret, moderately soluble in water, $O_3+3H_2O=3H_2O_2$ yielding a liquid (oxygenated water) partaking properties of gas O_3.	B (7). Very soluble in water, $SO_2+H_2O=H_2SO_3$ yielding a liquid partaking properties of gas SO_2.
A (8). Solution reduces Ag from its ammonio-nitrate.	B (8). Solution reduces Ag from its nitrate on heating.
A (9). Equilibrium of molecule, very unstable, *e.g.*, H_2O_2 converted to $2H_2O$ by nascent H, on one hand, and to H_2O+O_2 by addition of MnO_2.	B (9). Equilibrium of molecule somewhat unstable, *e.g.*, SO_2 converted to H_2S by nascent H, on one hand, and to H_2SO_4 on other by addition of MnO_2.
A (10). $3H_2S+O_3=3H_2O+S_3$.	B (10). $2H_2S+SO_2=2H_2O+S_3$.

These are almost as many concurrences as could be expected in the first two members of any homogeneous series, and are more striking than those of H_2S and H_2O, the first two terms of the series before quoted by way of comparison.

But to the whole of these observations I anticipate the objection, "Impossible! SO_2 is universally recognised as a reducer, O_3 as an oxidiser. You assimulate things of diametrically opposite tendencies, *e.g.*, O_3 blues iodised starch paper, SO_2 removes the blue."

To this, if the above instances of chemical resemblances be not sufficient answer, I ask, in reply, "Who shall, after Brodie's experiments on the peroxides, say what is an oxidiser? Why, oxygenated-water itself reduces MnO_2 and AgO! Why, in 10 (B), SO_2 is an oxidiser, not a reducer!"

Suffer me, then, to surmise that possibly the advance of chemical discovery respecting the allotropic conditions of oxygen may hereafter confirm that ozone belongs to the SO_2 type. This once admitted many other and important deductions must follow.

B. W. GIBSONE, B.Sc.

Eaton Square, June 18, 1870.

MISCELLANEOUS.

New Work on Quantitative Analysis.—Professor H. Storer, the talented Professor of Chemistry at the Institute of Technology, Massachusetts, is engaged on a work on Quantitative Analysis, the first part of which will be ready in August. It is arranged in dictionary form, and will be one of the most complete and valuable works extant on analysis. The first sheet, which is now before us, treats of the Quantitative Estimation of Acetic Acid, Acetate of Aluminium, Acetate of Barium, Acetate of Iron, Acetate of Lead, Acetate of Sodium (or of Potassium), Acetate of Uranium, Aconitin, Albumin, Alcohol, together with Acidimetry and Alcoholometry. If all the subjects are treated as fully as those in the first sheet, as we have no doubt they will be, the work will be welcomed by all chemists.

British Association for the Advancement of Science (Fortieth Meeting).—The Liverpool Meeting of the British Association for the Advancement of Science will commence on Wednesday, September 14th, under the presidency of Professor Huxley, F.R.S., F.G.S., &c. The facilities for communication with Scotland, Ireland, and America, as well as all parts of England, render it probable that this meeting will be very numerously attended; and it is the earnest wish of the local authorities, the representatives of the various scientific bodies, as well as of all those officially connected with the Association, that the members and associates should receive a cordial welcome, and that everything possible should be done to make the visit agreeable and instructive. Liverpool enjoys special advantages in its power of affording the various sections suitable accommodation within a limited area. There is much connected with the trade of Liverpool which cannot fail to be interesting to strangers. The river Mersey, with its line of docks, five miles in length; the great works at Birkenhead; the large warehouses, fitted with the latest mechanical appliances; the quay sides, covered with the various produce of all climes; and the numerous charitable institutions on the river, offer a class of attractions almost peculiar to Liverpool;—while

its shipbuilding yards, foundries, chemical, and various other works on an extensive scale, and its vicinity to the mining and manufacturing districts, enable it to meet the tastes of all classes of scientific men. The proximity of Chester and the coast of North Wales places many interesting spots within easy reach, and excursions will be planned, affording the members and associates an opportunity of visiting such as they may select. Arrangements have been made with the Railway, Ocean, and Coasting Steam Ship Companies for the conveyance of members to and from Liverpool at a reduced rate. The proprietors of the principal hotels have submitted a moderate tariff of charges, not exceeding their usual terms, and numerous offers of private hospitality have been placed at the disposal of the local officials. There is a foreigners' club, and there are a large number of foreign gentlemen, engaged in business, who will assist in providing for the comfort of those continental visitors who may attend. Those who require information and assistance in the way of providing lodgings, or other accommodation, are requested to communicate with the honorary local secretaries, Messrs. Wm. Banister, R. Harrison, H. H. Higgins, and A. Hume, at the Municipal Offices, Dale Street, Liverpool.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, June 13, 1870.

Omitting memoirs, papers, and communications relating to other departments of science, this number contains the following original matter on physico-chemical and collateral sciences:—

Specific Heat of Mixtures of Alcohol and Water.—Drs. Jamin and Amaury.—The authors, after briefly alluding to a former memoir on this subject, now proceed to give, in a lengthy memoir, a description of a series of experiments based upon the employment of a general algebraic formula, which, in fact, appears to be applicable not only to mixtures of water and alcohol, but also to various other liquids for the purpose of estimating the specific heat of mixtures of the same and of water. The paper is chiefly an algebraico-physical essay.

Physical Phenomena Observed during the Bursting of Hollow Cast-Iron Projectiles (Bomb-Shells, &c.), brought about by the Freezing of Water.—Dr. Ch. Martins and G. Chancel.—The authors reply to the observations and remarks made to their first communication on this subject by General Morin and other *savants*, and point out that the object they had in view while making these experiments, was to learn under what conditions, and with what phenomena, hollow cast-iron vessels (projectiles being most available for such purpose) will burst; moreover, the decrease of bulk of the bomb-shell, brought on by the cold, is only 1·33 c.c., a quantity too small to affect the experiment. The authors agree, however, with the General, that there is a very essential difference between the action of gunpowder and of freezing, although the ultimate effect is the same—viz., bursting of the projectile.

Cause of the "Rochage" of the Carburets of Iron, and on the Sparks Produced by these Metals.—H. Caron.—The author understands, by *rochage*, a peculiar production of sparks, best seen when molten cast-iron is run off from the blast furnace into moulds. In this lengthy paper, the author describes a series of experiments undertaken with the view to prove that, since steel and cast-iron, when molten in an atmosphere of hydrogen or oxide of carbon, never emit sparks, the production of the latter cannot be due to an evolution of reducing gas absorbed during the fusion, but is due, according to the author, to the formation of oxide of iron at the moment the molten metal comes in contact with air. When iron is kept fused in an atmosphere of hydrogen, its sp. gr. is increased from 7·84 to 7·88, while the metal becomes as soft and malleable as copper. When cast-iron is kept fused for a long time in a crucible, it absorbs oxygen, becomes lamellar, and, on cooling, contracts so suddenly as often to leave the inside of the mass hollow.

Mechanical Equivalent of Heat.—J. Violle.

Electrolysation of Air, or Oxygen, as a means of Producing Ozone.—A. Houzeau.—The author of this paper summarises, in thirteen corollaries, all facts relating to, and brought out by, a series of no less than 400 experiments made by him on this subject. The author also states that he has contrived what he calls an *ozoniseur*, a machine to convert, instantaneously, any desired quantity of air or oxygen into ozone.

Researches on Platinum.—P. Schützenberger.—The author states that the chloro-platinite of carbonyl, $COPtCl_2$, and the chloro-platinite of dicarbonyl, $C_2O_2PtCl_2$, may be viewed as being the chlorides of two diatomic compounds—viz., platoso-carbonyl, (COPt), and platoso-dicarbonyl—

$$\left(\begin{matrix}CO\\CO\end{matrix}\right\rangle Pt)$$

And, in order to prove the correctness of this view, describes at length, in this paper, the action of ammonia, of ether, of protochloride of phosphorus, and other reagents, upon the compounds alluded to, and upon the chlorides of platinum.

Tribromhydrine.—L. Henry.—The main object of this very exhaustive and lengthy memoir is to prove the absolute identity of tribromhydrine and tribromide of allyl.

Action of Ammonia upon Lecithine.—M. Gobley.—By the action of ammonia upon this substance, the author has succeeded in producing neurine, margaramide, and adipoglyceric acid. Samples of these substances were exhibited at this meeting of the Academy.

Hailstorm near Alais on May 29th last.—E. Bourgogne.—In a letter to M. Dumas, the author relates the particulars of a fearful hailstorm which has taken place in and around Alais (Département du Gard) on the above-named day, and which caused an immense destruction of property of various description, utterly destroying all crops, killing lambs, and covering the roads with hail to a depth of 30 centimetres (11·81 English inches). Most of the olive and nut-trees were decorticated, and a very old olive-tree cut off at the roots, and carried to a distance of 30 metres by the violent wind prevailing during the storm, the like of which has never been witnessed there before, being far more violent than that which took place in 1830 in the same locality.

The Bouma das Morts, near Alais.—The scientific committee occupied with the investigation of this grotto write to the Academy to say that they have discovered that originally this grotto was a lead mine, worked for the extraction of the ore of that metal, at a so remote period that it is at present difficult to form any opinion thereon; and it appears that, afterwards, the cavity has been either the habitation or the sepulchre of an extinct human race, the remains of which are now being fully explored.

Lowering the Temperature of Water.—A. Toselli.—The eminent Permanent Secretary of this Institute, M. Dumas, says—The author asserts that he has succeeded in lowering the temperature of water 13° C., by immersing, in that fluid, a tube spirally wound and turned round its axis. The author gives a complete drawing of that tube, but does not state how the experiment is to be made, nor what means employed to bring about the very desirable cooling, desirable especially during hot summer days.

The American Journal of Science and Arts, No. 147, May, 1870.

Omitting the titles, of the original papers and memoirs contained in this number and intended for full publication in our paper, we abstract and quote the following original papers relating to chemistry and collateral sciences:—

Method of Producing, by the Electric Spark, Figures similar to those of Lichtenberg.—E. W. Blake, jun.—The author reviews the history of electricity and the production of the figures alluded to, and then states—The method consists in throwing the discharge upon the surface of a fusible non-conducting body. If the body be near its fusing-point, the figure appears at once; if cold, a latent image exists, which may be developed by heat. The non-conducting surface is prepared by coating a plate of metal with an even film of pitch. Pieces of sheet tin, 3 inches square, coated with films of pitch of a thickness varying between 0·01 and 0·02 inch, were used; the pitch was the ordinary article of commerce, freed from sand, &c., by being melted and strained through a muslin bag. Shellac, resin, Burgundy pitch, bees'-wax, and Canada balsam were, in turn, tried as substitutes for pitch, but with unsatisfactory results. The author then describes (illustrating that description by woodcuts) his electric apparatus, and gives cuts, also, of the figures (Lichtenberg) as produced by frictional electricity and the induction coil.

Magnesium and Electric Lights as applied to Photo-Micrography.—J. J. Woodward.—A lengthy paper, illustrated by several engravings.

Mechanical Finger for the Microscope.—J. H. B. L.—With woodcuts.

Combinations of Silicon with Alcoholic Radicals.—C. Friedel and J. M. Crafts.—This lengthy memoir is divided into the following sections:—Silicic ethide; action of bromine on silicic ethide; the oxide of silicic tri-ethide; action of chlorine on silicic ethide; the acetic ether and the alcohol of silicic ethide; oxidation of silicic ethide; silicic methide; silicic ethide and methide.

Description and Analysis of the Franklin County Meteoric Iron; with Remarks on the Presence of Copper and Nickel in Meteoric Irons, the Method of Analysing the same, and the probability of the Lead in the Tarapaca Iron having been

originally foreign to that mass.—J. Lawrence Smith.—This rather lengthy paper treats, in its first section, of the Franklin County meteoric iron (sp. gr., 7·692); its weight was 24 lbs. Composition, in 100 parts—Iron, 90·58; nickel, 8·53; cobalt, 0·36; copper, minute quantity; phosphorus, 0·05.

Examination of a New and Extraordinary Gas-Well in the State of New York.—H. Wurtz.—This paper is chiefly of local importance; but the following brief scraps have a general bearing. It appears, in the first place, that some four years ago, the owner of a piece of ground in the township of West, Bloomfield County, Ontario, while boring for petroleum, struck, at about 500 feet below the surface, a cavity from which a copious stream of gas commenced blowing off at the rate of 400,000 cubic feet per day. The bore-hole is tubed down, and 5 inches in diameter; and the issuing gas, when burning, gives, in a still atmosphere, a flame 30 feet high. This phenomenon has now continued for fully four years. The gas consists, percentically, of—Marsh gas, 82·41; carbonic acid, 10·11; nitrogen, 4·31; oxygen. 0·23; illuminating hydrocarbons, 2·94;—sp. gr., 0·693.

Certain Double Sulphates of the Cerium Group.—C. H. Wing.

New Aspirator.—J. C. Draper.—Illustrated with a woodcut. The principle is that of the Giffard's injector.

Action of Sunlight on Sulphurous Acid.—O. Loew.—The author found that, when aqueous sulphurous acid was exposed in sealed tubes to the action of sunlight, it was gradually reduced to sulphur, but the oxygen was not liberated, another part of the acid having been oxidised by it to sulphuric acid.

Simple Method of Avoiding Observations of Temperature and Pressure in Gas Analyses, and on the Application of Sprengel's Mercurial Pump in Analysis.—W. Gibbs.—Illustrated with a series of algebraic formulæ and woodcuts.

Peculiar form of the Discharge Between the Poles of the Electric Machine.—A. W. Wright.—With diagrams.

Movement of the Dome of the Capitol at Washington during the Gale of December 10—12, 1869.—T. Walter.—Although the contents of this paper do not strictly belong to the subjects usually treated of in our periodical, we cannot refrain noticing the curious effects here recorded. The author had constructed a very sensitive apparatus to test the effect of the expansion of the Dome (an iron structure, 137 feet in diameter and 200 feet high) by the sun's rays; it happened, however, that the wind, and not the sun, made use of the author's preparations, and recorded its vagaries through the agency of the vast mass of the dome. One would think such a mass immovable against any action of wind; but this is not so. The author gives a diagram, proving what a gusty day was capable of effecting in giving motion to the mass. It is a well-known fact that tall chimney stalks and high church steeples, shot-towers, and the like, move about in rough weather, as also, perceptibly, do the high towers of Antwerp and Utrecht, though very massive buildings; but movements in a dome such as that alluded to could hardly have been reasonably expected.

Zeitschrift für Chemie von Beilstein, No. 9, 1870.

This number contains the following original papers and memoirs:—

Action of Nitric Acid upon Azotoluide.—W. Petrieff.—When nitric acid (sp. gr., 1·5) is added to azotoluide, and care taken to cool the mixture, mononitro-azotoluide is formed which is almost entirely soluble in alcohol. On evaporating this solution, two substances are obtained, both composed of $C_{14}H_{12}(NO_4)N_2$; one of these bodies, a red substance, fuses at 67°; the other, yellow, fuses at 63°. When, however, crystals of azotoluide are added to strong nitric acid, without cooling, two other substances are formed—viz., trinitro-azotoluide, soluble in boiling alcohol, difficultly soluble in ether, fusing at 185°, formula $C_{11}H_{11}(NO_2)_2N_2$; and a body insoluble in alcohol, but soluble in benzol and nitric acid, fusing at 201°, exploding violently when heated to a higher temperature; formula, $C_{13}H_{11}(NO_2)_2N_2O$. The author has also tried to obtain these substances by the action of nitric acid upon azobenzid; but this reaction did not lead to the desired results, azoxybenzide being formed. The action of pentachloride of phosphorus is as follows:—

$$C_{12}H_{10}N_2O+PCl_5=C_{12}H_{10}N_2+PCl_3O+Cl_2.$$

A Body Homologous with Benzidine.—W. Petrieff.—Hydrazotoluide is converted, by the cautious addition of sulphuric or chlorhydric acids, into a crystalline body homologous with benzidine, fusing at 128°, and readily soluble in boiling water, alcohol, and ether. This base yields, with sulphuric acid, two different salts, one of which is soluble in boiling water and in alcohol, the other insoluble therein; the formula of the latter is $C_{14}H_{16}N_2+2H_2SO_4$. The author observes that he obtained this body only from hydrazotoluide, prepared, by means of sodium amalgam, from hydrazotoluide.

Action of Hydrobromic Acid upon Azoxybenzide.—R. Sendzink.—When hydrobromic acid acts upon azoxybenzide, a substance is formed which proved to be bibromaniline—

$$C_{12}H_{10}N_2O+4HBr=2C_6H_5Br_2N+H_2O+H_2.$$

This reaction, however, only takes place when a large excess of hydrobromic acid is taken; with a small quantity of the latter, an oily substance is obtained, and very little bibromaniline. Hydriodic acid converts azoxybenzide very readily into benzidine.

Researches on the Allyl Group.—B. Tollens.—The author, referring, first, to some of his former experiments on this subject, states that allyl-alcohol, obtained by him, does not yield, when treated with substances which give off hydrogen, either propylic or isopropylic alcohol. The preparation of allyl-alcohol from glycerine and oxalic acid, is rendered difficult, by reason of a small quantity of alkali, almost always present in oxalic acid, and very difficulty removable from it. The author, therefore, adds from ½ to 1 per cent of hydrochloric acid, whereby this objection is obviated. Sulphuric acid may be used, but excess of either should be avoided, especially since even a slight excess of chlorhydric acid causes, at about 200° (the most suitable temperature for the reaction), the formation of mono-allyline—

$$C_3H_5\begin{cases}OH\\OH\\OC_3H_5\end{cases}$$

a liquid boiling at 240°, but then, also, partly decomposed.

Some Additional Observations on the Formation of Ozone in a Flame.—O. Loew.—This paper is written as a reply to some remarks published by Dr. Böttger on the author's observations on this subject, wherein the former chemist says that peroxide of hydrogen and carbonate of ammonia are formed in the manner described by the author (see CHEMICAL NEWS, vol. xxi., p. 107). The author now states that, by using a pair of bellows and a large Bunsen gas burner, he has filled, in a short time, a large room with the peculiar odour due to ozone, while delicate tests failed to detect any peroxide of hydrogen or carbonate of ammonia.

Revue Hebdomadaire de Chimie, June 2, 1870.

Analysis of Three Sorts of Corn cultivated near Saulsaie (Departement du Rhône).—Dr. J. Roussille.—This grain (wheat) had been grown experimentally for the purpose of trying a peculiar kind of soil containing no less than 88·9 per cent of silica insoluble in hydrochloric acid. The sorts of corn are termed *bleu*, *rouge*, and *fern*, and were found to contain, in 100 parts, respectively—Water, 14·2, 14·10, 15·32; organic matters, 84·8, 84·22, 82·78; mineral matter, 1·72, 1·68, 1·9. The yield per hectare of each was, in kilos. of the thrashed-out grain, 2576, 1419, and 1956. The soil alluded to contains 0·060 per cent of phosphoric acid and 2·17 per cent of organic matter.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 1, 1870.

This periodical appears only quarterly, and is, moreover, rarely published with great accuracy as to date of publication, it being an official, not a commercial undertaking.

This number contains the following original papers relating to physico-chemical and collateral sciences:—

The Town of Oldenburg and its Environs in relation to Water Supply.—H. Wolf.—The town alluded to is in Hungary. The lengthy memoir deserves special notice as an excellent contribution to economico-geological surveys of this description. The paper is illustrated with maps and engravings.

Report on the Production and Circulation of the Mineral Fuels, and the Localities where these are Found and Wrought in the Austro-Hungarian Monarchy.—F. Fœtterle.

The Kainite from Kalusz, in Galicia.—Karl Ritter von Hauer.—The celebrated author of this lengthy memoir states that the kainite found in large quantity at the locality alluded to contains, on an average, in 100 parts—Sulphuric acid, 20·46; chlorine, 28·01; magnesia, 10·16; potassium, 16·38; sodium, 7·97; calcium and protoxide of iron, a trace; water, 14·36; clay, 3·41. Formula, $KCl+2(MgO.SO_3)+6HO$. The kainite here alluded to agrees very closely in composition with that found near Stassfurth. The author enters, at great length, into details about the manufacture of salts of potassa from this mineral.

Revue des Cours Scientifiques de la France et de l'Etranger, June 11, 1870.

This number does not contain any papers directly relating to chemistry; but it contains a lengthy and very clearly-written paper, illustrated by several woodcuts, on the—

Use of Steam-Backing in Locomotive Engines.—M. Le Châtelier.

And a lengthy lecture by the celebrated Heidelberg physiologist, Dr. Helmholtz, on the—

Physiological Action of Electric Currents of Short Duration in the Interior of Conducting Bodies.

Les Mondes, June 9, 1870.

The Arènes at Paris.—Rev. Michon.—A lengthy paper illustrated with several woodcuts, and describing the various objects of scientific and historical interest found in this very ancient building, which, for some centuries, has been covered over by the mould and rubbish of a city of later date.

Experiments on the Physiological and Therapeutical Properties of Phosphate of Lime.—Dr. R. Dusart.—The chief point of interest in this paper is that phosphate of lime, in some form or other, is absolutely required for the proper performance of the functions of nutrition, since it causes the albumenoid substances to form cells and tissues. The author speaks of a lacto-phosphate of lime as a therapeutic agent, but does not specify what that substance is; it may be a double salt of lactic and phosphoric acid with lime.

Distances at which Sound can be Heard.—Rev. F. Moigno.—The fog-horn established at Foucher can be heard, in calm weather,

at a distance of 28 kilometres; during storms, at a distance of from 9 to 15 kilometres; and with wind blowing in the direction wherein the sound is sent (seaward), 46 kilometres. The cannonade at the battle of Waterloo (June 18, 1815) was heard at Creil (France), 200 kilometres distant therefrom; and the cannonade at the battle of March 30th, 1814 (near Paris), was heard distinctly at Casson, between Lisieux and Caen, at 176 kilometres' distance, in each case as the crow flies.

Conversion of an Ordinary Electric Machine into a Holtz's Machine.—Rev. Dr. Laborde.—A lengthy paper wherein the author points out how the desired object can be obtained, temporarily, for the purpose of lecture-room experiments.

Cosmos, June 11, 1870.

Effects of Cold upon Plants.—Dr. Zurcher, writing from Toulon, states that on the night from the 3rd to 4th of January last, the thermometer in the public garden of the town alluded to marked $-8°$, and that a large quantity of snow covered the ground and the trees, among which a number of palm-trees, and even *Chamaerops* and *Jubea*, none of which, though exposed to this low temperature, suffered any damage. From observations made by the author and several other parties, it appears that, as regards the injury done to the plants by great cold, the effects thereof do not depend so much on the degree of cold, as on the calmness of the air (absence of wind) and absence of moisture.

Means of Detecting the Genuineness of Kirschwasser.—S. Meunier.—Place, in a test-tube, some powdered guaiacum-wood, and add to it some of the Kirschwasser to be examined. If the latter is really genuine, an indigo-blue colour will forthwith appear, and continue for about an hour; but, if the liquor has been prepared with essential oil of almonds, *Aqua laurocerasi*, or crushed cherry-stones macerated in alcohol, only a yellow tint will be produced. The rationale of this curious phenomenon is not explained, and will be the subject of further investigation. Kirschwasser contains, when genuine, hydrocyanic acid, hydride of benzoyl, and a peculiarly-flavoured essential oil not known in the isolated state.

Moniteur Scientifique, No. 324, June 15, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and collateral sciences:—

Experiments on the Salts of Manganese.—Dr. A. Commaille.—The author describes at length the action of acids upon permanganate of potassa, aided, in some instances, by the reducing action of alcohol, ether, and electricity. The author observes, casually, that the salts of the protoxide of manganese are, when perfectly pure, quite colourless. The memoir is divided into the following sections:—Nitric acid and permanganate of potassa; sulphuric, hydrochloric, iodic, arsenious, oxalic, acetic, tartaric, citric, tannic, benzoic, and uric acids, respectively, with permanganate of potassa. The author found that, under the influence of the electric current and chlorhydric acid, hydrogen gas alone is given off from the permanganate; the same is observed, under similar conditions, with oxalic acid.

Palm Oils of Commerce.—P. Guyot.—Palm oil is obtained from the fruit of the *Avoira* or *Crocro* palm-tree, growing on the coast, and also in the interior of the Guinea. It yields two kinds of oil—viz., a white-coloured, butter-like substance, extracted from the kernel of the fruit, and chiefly used by the natives as food; the point of fusion of this oil is stated to be rather high. The other kind is extracted from the fibrous sarcocarpon surrounding the fruit; at the prevailing temperature of its native country, this oil is fluid, but in Europe it has the consistency of butter; its colour is yellowish orange, and its smell is very much like that of violet flowers; it is insoluble in cold as well as boiling water, slightly soluble in alcohol, and very soluble in ether. The author gives, in a tabulated form, the results of the action of different reagents upon the oil alluded to, and some of the commercial varieties thereof, as imported from other countries where the oil is obtained either from the same or some other kind of palm-tree. The action of the reagents alluded to (sulphuric and nitric acids, ammonia, chloride of zinc, protochloride of tin, pernitrate of mercury, and liver of sulphur) is not sufficiently characteristic to be specifically quoted here; and this is the less necessary, because, as the author also states, adulteration of these oils would not be practised in the country whence they are exported, and certainly not in Europe, unless it were done in a very wholesale manner, and with the application of very inferior fats. The complete solubility in ether is a sufficient test of purity; the colouring matter is readily destroyed when desired.

Extraction of Copper from its Ores.—MM. Tessié du Motay and Co.—The authors propose to apply their oxyhydrogen gas for the purpose of oxidising, from copper ores, the other metals they may contain, after such ores have been previously treated so as to be in the state of metallic silicates, as they call it.

Application of Phenic Acid for the purposes of Leather and Skin Manufacture.—E. L. C. Baudet.—The author describes, at great length and very exhaustively, all the operations whereby hides and skins are converted into what is generally called leather, and proposes the use of phenic acid as a preservative against various kinds of injury the raw, as well as the ready-made materials are subjected to, from various causes, both during and after their conversion from hides and skins into saleable commodities.

Detection of Bone-Cuttings among Rasped Hartshorn.—F. Cyrias.—The author advises to take 2 grms. of the material to be tested, to eliminate, first, the adhering dust by means of a fine sieve; next, to dry it at 100°; and then to boil it for an hour with water, to collect the insoluble residue on previously-counterpoised filters, to wash well with boiling-hot water, and to weigh after drying. If the loss in weight is below 6 per cent, the conclusion, says the author, may safely be that the sample in question does not contain even a trace of genuine hartshorn; if the loss by weight is above 6 per cent, the number, 6, should be deducted from the quantity found, which should be designated as n; and the proportion, supposing 10 per cent loss to have been found, will stand—$8 : 100 = 4 : x = 50$ per cent of genuine hartshorn. Since, however, the use of hartshorn, as well as of such preparations as the once renowned *Decoctum album Sydenhami*, are now altogether forgotten, and superseded by more simple substances, this test has only a scientific interest, as indicating in genuine hartshorn a far larger amount of matter soluble in water than is present in bones.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 3, 1870.

This number contains the following original papers relating to physico-chemical sciences:—

Meteorite from Saint-Denis-Westrem, near Ghent.—S. Meunier.—This stone, weighing 720 grms., which fell from the sky on the 7th of June, 1855, the fall being accompanied by a loud detonation and strong emission of light, belongs, according to the author, to what he terms *luceite*, a white-coloured, fine-grained, harshly-feeling very crystalline substance (sp. gr., 3·43) consisting for 88·9 per cent of a lithoid matter, made up of silica, magnesia, oxides of iron, alumina, soda, and potassa, with traces of lime and oxide of chromium. Fully 65 per cent of this quantity is soluble in chlorhydric acid. By means of the magnet, about 8 per cent of metal, chiefly iron, is separated. The paper contains an exhaustive discussion on the origin of meteorites; and the author states that our moon is gradually tending more and more to become broken up into smaller spheroids, some of which may reach our globe as meteoric stones at a future day.

Discovery of a Layer of Native Phosphate of Lime under the City of Leuven (Louvain), Belgium.—G. Lambert.—It appears that the municipal government of the city alluded to have, for some purpose or other (not specified), been making borings deep into the soil in a central part of that place. Among the minerals obtained are—At a depth of 110 metres from the surface, a layer of a material containing—water driven off at 100°, 1·28 per cent; water driven off at red-heat, after drying at 100°, 6·42 per cent; insoluble in chlorhydric acid, 16·42 per cent; anhydrous phosphoric acid, 29·90 per cent. This material contains, therefore, about 62 per cent of tribasic phosphate of lime.

NOTES AND QUERIES.

Bromine.—Can you, or any of your readers, give me a thoroughly-accurate process for the separation of bromine from bromic acid, where the two exist together as a bromide and bromate of an alkali. —J. H. Watson.

Phosphate of Ammonia.—(Reply to "J. W. M.")—You will find, in any of the larger works treating on chemistry, what you require. Consult the excellent work of Dr. W. A. Miller, or Watts's "Dictionary," and the works of the late Dr. Brande, &c., all of which you can inspect at the Library of the Commissioners of Patents.

Persulphide of Hydrogen.—I should feel obliged if you can inform me whether the actual composition of persulphide of hydrogen has ever been demonstrated analytically, as I am endeavouring to attain this myself.—W. B. G.

Method for the Removal of Stains of Iron Mould from Fabrics. The removal of these stains is a matter of some difficulty if they have remained on a fabric for some time. The usual substances employed for this purpose (oxalic acid or quadroxalate of potassium) require placing, in concentrated solution, in contact with the material for a considerable time, thereby materially weakening and rotting the fibre. The following method is free from this objection, and will remove stains of long standing almost immediately:—Wet the mark with yellow sulphide of ammonium, by which it will be immediately blackened, and allow it a minute or so to penetrate; then wash out the excess of sulphide, and treat the black spot with cold dilute chlorhydric acid, by which it is immediately removed. Finally, wash well with water.—W. B. G.

TO CORRESPONDENTS.

J. R.—The method given in Fresenius may be relied on.

W. N. (Huddersfield).—There is no objection to the use of hydrochloric acid instead of sulphuric in the preparation of CO_2, provided the gas is washed with carbonate of soda solution.

F.C.S.—Your letter has been referred to the reporter.

B. W. Gibsone.—Thanks for your paper; it shall be inserted in an early issue.

James R. Gregory.—We have received your catalogue of minerals, &c.; it seems to be very complete, and the prices being affixed makes it valuable to all mineralogists.

J. Pattison.—A work by the Editor, embracing both the subjects you name, is in the press.

Chrome Colour.—There is a letter for this correspondent at our office.

J. W. M.—Send your address to our publisher.

INDEX.

ABRAHAMS, P. S., homologues of cupric aceto-arsenite, 265
Acetic acid from urine, 247
  acid, synthesis of from acetylen, 274
  vapour density of, 190
  vapours, injurious action of, 275
Aceto-chlorhydrine from octyl-glycol, 58
Acetone, new derivatives of, 216
  products of, oxidation of, 143
Acetones from mercuro-diphenyl, preparation of, 203
  preparation of, 216
Aceton-sulpho acid, 202
"Acetopathy" (review), 79
Acetylen, action of on aceto-hypochlorous anhydride, 262
  chloride of, 107
  synthesis of acetic acid from, 274
Acid, anthranilic, action of cyanogen on, 6
  butyric, detection of in glycerine, 58
  carbonaphtholic and naphthol, 58
  carbonic, tanning by means of, 288
  chloro-chromic, action of on benzol, 12
  glacial acetic, quantitative estimation of, 286
  hydrated hydrobromine, preparation of, 286
  hydrobromic, action of on azoxybenzide, 299
  hydrochloric, action of on nitrobenzol, 34
  hydrosulphuric, synthesis of, 46
  hypophosphoric, use of in agriculture, 59
  nitric, action of on azotoluide, 299
  nitrous, 45
  reduction of by metals, 286
  oxalic, electrolysis of, 70
  sulphuric, combination of with oxides of nitrogen, 24
  sulphurous, action of sunlight on, 299
  and ozone, 297
  terephthalic, synthesis of, 47
  titanic, preparation of and separation from zirconium and iron, 120
Acids and alcohols, ethereal derivatives of, 70
  hydriodic and hydrobromic, specific gravity, percentage, and composition of at various temperatures, 286
  neutralisation and basicity of, thermo-chemical researches on, 203
  organic, simultaneous action of the intra-pilair current and nascent hydrogen on, 22
  synthesis of, 143
  selenic and selenious, preparation of, 46
  sulpho-nitrogen, 58
  synthesis of organic, 82
  uvic, formic, glycolic, and glyoxycolic, 58
Acoustic attraction and repulsion, 287
Acroleine, chemical constitution of, 286
Acrylic acid, formation of, 239
"Addresses at the inauguration of C. W. Eliot as President of Harvard College" (review), 32
Adirondack mineral springs, 83
Adrian, M., bromide of potassium, 82
Agaricus, white, two products from the, 45
Aigues-Mortes, has the sea ever been quite close to? 228
Air, absorbing moisture from, 155
  composition of at various heights, 166
  of given off by ignited charcoal, 251
  continuous current of, 192
  decrease of temperature of, 167
  estimation of ammonia in, 138
  layer of, vibrations of a, 60
  organic matter in the, 64, 65, 78
  or gas under pressure, obtaining a continuous current of, 173
  or oxygen, electrolysation of as a means of producing ozone, 298
  presence of peroxide of nitrogen in, 156
Air-pump, mercurial, 119
Albolith, 167
Albumen, egg and blood, 60
  consumption of for industrial purposes, 142
Alcohol, action of chlorine on, 94
  action of chlorosulphide of phosphorus on, 88
  and water, specific gravity of mixtures of, 298
  effect of on the human body, 253
  impure, injurious effects of on aniline colours, 35
  propylic, synthesis of by means of ethylic alcohol, 57
  testing for amylic alcohol, 143
  and water, maximum density and the freezing of, 250
Alcohols, new reactions of, 66
  normal propylic, butylic, and amylic, stability of the, 118
Alder tree, colouring matter of, 131
Aldehyde, action of chlorine on, 286
Aldehydes, constitution of the, 203
  propylic, butylic, and amylic, 119
Alicante, meteorite observed at, 142
Alizarine, artificial, 35, 43, 57, 71, 138, 185, 239
  preparation of from madder, 81
Alkali apparatus, 227
  waste, hyposulphite of soda from, 72
Alkaline lakes in California, 83
Alkaloids, electrolysis of, 82
Alloys, metallic, 84
Allyl group, researches on, 299
Allylic compounds, combination of with chloride of iodine and hypochlorous acid, 202
Alum, 107
Alumina, 144, 156
  and iron, separation of, 54
  from the island of Eubœa, 12
Alunite of Mont-Dore, 214
Alvergnat and Frère's drop apparatus for fluids, 10
Amagat, A., modification of Fortin's barometer, 142
Amaury and Jamin, Drs., specific heat of mixtures of alcohol and water, 298
"American Pharmaceutical Association" (review), 177
Amido-dicyanic acid, 191
Ammonia, action of on lecithine, 298
  bicarbonate of in illuminating gas, 192
  chromium bases, 235
  and magnesia, double arsenate of, 193, 213
  nitric acid, detection of, 250
  strontia, manufacture of soda by the use of, 36
  estimation of in air, 138
  gunpowder, 95
  hydrocyanide of, base isomeric with, 101
  machine, 288
  nitrate of, 275
  phosphate of, 264, 276
  reaction of phenol on, 250
  sulphate of, 180, 192
Ammoniacal compounds, dissociation of, 6
Ammonium amalgam and hydrogenium, 265
  bicarbonate of in the coal gas at Munich, 227
  carbamate, precipitation of solutions of by calcium chloride, 247
Ampère's apparatus, 287
Analytical chemistry, new work on, 227
Analysts' fees, 213
Andersonian University, 158
André, M., velocity of sound in water, 142
Andrews, T., continuity of the gaseous and liquid states of matter, 101, 111
Anemometer, a new, 200
Angelic acid, reduction of to valerianic acid, 70
Anhydrous sulphuric acid, action of on some of the chlorine and sulphur compounds, 287
  some reactions of, 70
Aniline black, 275
  blue, 11
  colours, 236
  arsenic free and arsenic containing, 178
  injurious effects of impure alcohol on, 35
  instantaneous apparition of, 143
  red, free from arsenic, 35
Animals, lower organised, chemical conditions of the life of, 154
Anthracen and alizarin, 252
Anthracen-carbonic acid, 70
Anthracene, 132
Anthranilic acid, action of cyanogen on, 6
  Anthropophagi of Chauvaux, 251
Antimony, black sulphide of, obtaining a regular stream of sulphuretted hydrogen from, 226
  separation of tin from, 124
Antwerp, national congress for geographic, cosmographic, and commercial sciences at, 191
Apjohn, J., M.D., proximate analysis of saccharine matters, 86
Appolt, T. and E. Pericot, carbonisation of dry coal, 119
Aqueous solutions, specific gravities of, 155
Archæological discoveries, 251
Archibald, H. C., granular citrate of magnesia, 263
Arènes at Paris, 299
Areometer, Baumé's, 54
  combined, 168
Areometers, metallic, 215
Ariège, mineral resources of the 192
Armstrong, M., reactions of anhydrous sulphuric acid, 70
Arnot, W., notes from the laboratory of a sugar refinery, 1, 25, 37, 49, 61
Aromatic acid, synthesis of, 95, 118, 203, 239
  amido acids, new derivatives of, 251
Arsenic and copper, separation and estimation of, 133
  in rosaniline, 70
  aniline-red free from, 35
  separating tin from, 124
Ascher, M., reduction of angelic acid to valerianic acid, 70
Asparagus berries, chemical constituents of, 216
Asphyxia, by carbonic vapours, 226
  produced by the fumes of charcoal, 275
Aspirator, a new, 155, 299
Atmosphere, dust in, 180
Atom-fixing and atom-displacing powers, 109, 145
Atomic formulæ, 155
"Attfield's Saturation Tables" (review), 212
Attwood's machine, improved, 251
Aurora borealis, 119, 190, 202
  at Nantes, 36
  effect of on telegraph wires, 226
Austria and Hungary, mineralogical topography of, 131
Autocollimation, Foucault's method of, 119
Autun, some silicified vegetables met with near, 57
Auvillain, M., a new manure, 202
Avogadro's law, 252, 275
Azo compounds, 203
Azotoluide, action of nitric acid on, 299
Azoxybenzide, action of hydro bromic acid on, 299
Azoxytoluide, 35

BACKER, L. de., earthquakes and volcanic explosions in the Netherlands' Indies, 202

Baeyer, M., formation of nitro bodies, 70
mesohydromellitic and tetrahydrophthalic acid, 190
and Emmerling, MM., synthesis of indol, 70
Bähr-Predari, M. R., chlorophenolsulpho acid, 70
Baker, W., analysts' fees, 213
Balloon, explosive, 173
Bardeleben, Dr., combined areometer, 168
Barford, Dr., action of formic acid on lead salts, 94
Barometer, Fortin's modification of, 142
improved, 180
influence of phases of the moon on height of, 36
registering by photography, 94
and thermometer, relation between the variations of the, 155
Barthélemy, M., freezing of water, 57
Barwood red and indigo blue, 168, 180
Baryta, hypobromite of, as a reagent, 191
Bastelaer, A. D. van., adulteration of rice-meal, 155
Bastuert, A., titration of chlorine and Eaux-de-Javelle liquors, 215
Batswing burner flame, 262
Battery, galvanic, universal, 47
Battey, Dr. R., sulphate of lime, 263
Baubigny, H., researches on camphor, 120
Baudin, M., on Baumé's areometer, 54
Baudrimont, M., adulteration of cochineal, 131
batswing burner flame, 262
estimation of bromide of potassium mixed with chloride, 143
tin-foil for the preservation of perishable substances, 274
Baumhauer, Dr., action of hydrochloric acid on nitrobenzol, 34
preserving wood, 47
Bauxite, 276, 288
Béchamp, M., formation of urea, 202
geological microzymas of different origin, 214
preparation and fermentation of pyro-tartaric acid, 226
Becquerel, M., electric currents produced by contact of metals and water, 225
electro-motive power of divers substances, 129
electro-depositing nickel on other metals, 57
Beer, stale and ropy, regenerating, 154
Beer-yeast as a manure, 36
vitality of, 154
Beers, Bavarian, Vienna, and Belgian, 96
Beet-juice, extraction of, 275
evaporation of, 143
Beet-root leaves, preservation of, 202
sugar, 13, 120
distillation of, 179
Beet-roots, exhausted, utilisation of as fodder, 168
Beilstein and Kuhlberg, Drs., chlorinated derivatives of toluol, 95
isomeric nitrotoluols and toluidines, 154
Bell, Dr., Adirondack mineral springs, 83
J., fermentation, 294
Bells, new method of hanging, 227
Bender, Dr., aceton-sulpho acid, 202
Benrath, H. G., rapakiwi for the manufacture of bottle glass, 168
Benzidine, a body homologous with, 299
Benzilic acid, 286
Benzoates, metallic composition of some, 215
Benzoic acids, di- and tri-nit rit 203
Benzoic acid and gum benzoi
Benzoin, gum, and benzoic acid, 142
Benzol-aldehyde and primary monamides, 275
Benzol, action of chloro-chromic acid on, 12
formation of chlormaleinic acid from, 239
sulpho-acids of, 242, 255
Benzyl, optical properties of, 286
Berlin, M., preparation of lepiden from thionessal, 82
Bernier, M., beer-yeast as a manure, 36
Berries, yellow, pigment contained in, 11
Bertholle, Dr., spontaneous combustion, 119
Berthelot, Dr., action of oxychloride of carbon on carbides of hydrogen, 107
action of potassa on sulphuric derivatives of hydrocarbons, 274
different varieties of carbon, 274
oxidation of hydrocarbons, 274
synthesis of acetic acid from acetylen, 274
aggregation of sulphur, 214
analyses of gases containing oxychloride of carbon, 107
chemical equilibrium, 4
chemical equilibrium between carbon, hydrogen, and oxygen, 143, 169
isomerism of the elementary bodies, 288
on trichlorydine and substances isomeric therewith, 166
oxychloride of carbon, 107
preparation of pure nitrogen, 250
reaction of phenol on ammonia, 250
trichlorhydrine, 287
and Jungfleisch, MM., laws which regulate the division of a body between two solvents, 217
Bessemer flame, spectrum of the, 79, 80
Betaine, 203
Bibliography, 240
Bichromate battery, 238
Bile, pigment in, 227
Binitronaphthol, formation of, 59
Bischoff, Dr., value of fire-clays, 71
Bismuth, coating brass with, 168
sub-nitrate of, adulteration of, 143
Black, aniline, 275
snow, 191
Blake, E. W., jun., producing by the electric spark figures similar to those of Lichtenberg, 298
Blanchard, E., scientific work done in the departments of France, 251
Blast-furnace, application of gas to, 168
Bleckrode, Dr., a new aspirator, 155
Blondlot, M., black phosphorus, 201
Blood, 191
albuminous substances of the, 47
globules, 82
formation of, 286
manganese in, 274
stains and sand, 237
Blunt, T. P., analysis of water, 249
estimation of chlorine in water, 217
Blumer-Zweifel, M., aniline blue, 11
Bobierre, M., volumetric assay of iodine, 143
Bocardo, G., peculiar rain, 251
"Body and its Health" (review), 55
Boiling, experiments on, 11
Bolley and Hummel, MM., phenyl-brown, 59
Bolley, Dr., researches on Yama-Mai silk, 59
Boillot, M., synthesis of hydrosulphuric acid, 46
Boletus laricis, products of the, 167
Boital, F., production of petroleum gas, 227
Bolas and Groves, MM., tetrabromide of carbon, 223
Boltzmann, M., reply to the critics of, 60
Bone, picric acid for imparting red colour to, 226
Bone-cuttings, detection of among rasped hartshorn, 300
Bonjean, M., poisoning with hydrocyanic acid and cyanides, 130
Bontemps, M., manuscripts, 82
Boracic acid, ethers of, 178
Borax, Californian, 91
Boron, heat evolved by its union with chlorine and oxygen, 70
Bosch, B. C., pumpkin seeds, 263
Bottle-glass, rapakiwi for the manufacture of, 168
Brucine and its salts, behaviour of hypochloric acid with, 167
Bouilhon, M., preparation of neutral perchloride of iron, 143
Bouma das Mortes, near Alais, 298
Bourgoin, M., electrolysis of alkaloids, 82
nitric acid, 190
Bourgogne, E., hailstorm, 298
Boussingault, M., estimation of carbon in iron and steel, 120
Boutica, Rev. L., machine for peeling potatoes, 215
Brammer, F., improvement in white-lead manufacture, 252
Brass and copper, coating cast-iron objects by electrolysis with, 246
coating with bismuth, 168
Brazil, coal in the, 119
Bread and railway-sleepers, 24
chemically-prepared, 287
estimation of starch in, 94
wheaten, 231
Breath, human, organic matter of, 127
Brewing, residues of, 240
British Association for the Advancement of Science, 297
Brizot, J. E., preparation of seaweed, 251
Bromal, hydrate of, 23
Bromhydric acid, 154, 226
Bromine, 300
action of on dichlorhydrine, 286
action of on ethyl-benzol, 52
Bromoform, bromal, and iodal compared with chloroform and chloral, 94
Bromotoluen and paratoluidine, 107
and pseudo-toluidine, 143
Bronze, application of mica as a substitute for, 285
Brown, H. T., estimation of ammonia in air, 138
Brown hair-dye, 263
Brunswick, water supply of, 252
Bryonicine, 227
Bulk, changes of during formation of solid compounds, 179
Bunsen, Prof., separation of the platinum metals, 39
Bunsen's pump, use of a bell-jar and beaker with, 236
Burckhard, P., electrolytic experiments, 238
Burgess, J. G., reactions of disulphide of carbon with baric and calcic hydrates, 81
Burning bodies, illustrating gain in weight of, 273
Burt, P., action of green light on the Mimosa pudica, 94
Butlerow, A., trimethyl-carbinol from isobutyl-alcohol, 263
Butter, artificial, 142
Butyl iodide, conversion of, 275
Butylen, 263
Butyric acid in glycerine, detection of, 58
Byasson, Dr., cerebral activity, 191
CAFFEIC acid, preparation of, 143
Cailletet, L., compressibility of gases, 262
Calcium and zinc, crystalline alloy of, 273
chloride of, supersaturation of, 166
light, use of, 190, 239
phosphide of applied to life-buoys, 119
Calcium-chloride, precipitation of solutions of ammonium-carbonate, sodium-carbonate, and ammonium-carbamate by, 247
California, alkaline lakes in, 83
tin in, 225
Calorific spectra, 225
Calorimeter, mercurial, 70
Calorimetry, application of an electric current in, 166
Calvert, Dr. F. C., composition of iron-rust, 42
oxidation of iron, 119
testing petroleum, 85
Cameron, C. A., analysis of carbonates, 104
Campbell, A., Californian borax, 91
Silician sulphur, 91
Camphor, constitution of, 203
researches on, 120, 179
Contet, M., manufacture of disulphide of carbon, 11
Caoutchouc, artificial, 72
of Gaboon, new substance from, 11
tubes, permeability of, 12
Cap Garonne copper-mine, minerals found in the, 226
Capillary phenomena, theory of, 179
Carbon, different varieties of, 274
disulphide of, action of on charcoal, 153
hydrogenated derivatives of, 154
in coal-gas, estimation of, 95
manufacture of, 11
reactions of with baric and calcic hydrates, 56
rendering inodorous, 22
solid, 131, 190
estimation of in iron and steel, 120
hydrogen, and nitrogen, estimation of, 120
and oxygen, chemical equilibrium between, 143, 169, 214
in pig-iron, estimation of, 167
in steel, determination of, 295
oxide of, absorption of by the lungs, 274
and protochloride of platinum, 262
oxychloride of, action of on carbides of hydrogen, 107
analyses of gases containing, 107
and benzine, reaction between, 287
proto- and sesqui-chloride of, action of sulphuric anhydride on, 262
tetrabromide of, 223, 236, 273
Carbon-japania, 11
Carbonaphtholic acid and naphthol, 58
Carbonates, apparatus for analysis of, 104
mineralogical formula of, 70
Carbonic acid, formic acid from, 178
reagent for estimation of, 72
tanning by means of, 288
Carius, L., action of bromine on dichlorhydrine, 286
formation of chlormaleinic acid from benzol, 239
maleinic and phenaconic acids, 239
preparation of dibromacetic acid, 239
Caron, H., cause of the "rochage" in carburets of iron, 298
solution of reducing gases by molten iron, &c., 119

Carstenjen, M., action of chloro-chromic acid on aromatic hydrocarbons, 23
action of chloro-chromic acid on benzol, 12
Casselman, W., action of solutions on glass and porcelain, 167
Castelhaz, M., bromide of potassium, 238
bromide of sodium, 58
Cast-iron, coating with copper and brass, 246, 273
Catalpa bignonoides, 263
Catechu, adulteration of, 178
Caventon and Willm, Drs., iodo-mercurate of copper, 227
Caustic soda and lime, 156
manufacture of, 148
Candle-bearing tree, 130
Cellulose, dissolving, 144, 156
Cerasus acida, substances met with in the bark and leaves of, 34
constituents of fruits of the, 203
Cereals, parasites on, 251
Cerebral activity, 191
Cerium group, certain double sulphates of, 299
metals, salts of, 264
Chabacite, composition of, 216
Chabrier, Dr., testing glue, 264
Chain-pump for work in thickish liquids, 215
Chalk-mud, or ooze, from the Atlantic sea-bed, composition of, 91
Champion and Pellet, Drs., preparing bromhydric acid, 226
Chancel, G., and Ch. Martins, physical phenomena observed during the bursting of hollow cast-iron projectiles, 298
Chapman, E. T., organic matter in the air, 65
reactions of alcohols, 66
Charcoal, absorption of mixed vapours by, 43
action of sulphide of carbon and carburetted gases on, 153
animal, preparing, 143
estimation of sulphur and gypsum in, 35
revivification of, 275
Chemical action, general theory of, 57, 142, 178
combinations, cause and nature of, 287
elements, 252
equilibrium, 4
nomenclature, new, 84, 239
phenomena, 106
Society Council, 92
President's address, 159
Chemistry, application of Avogadro's theorem to, 47
female students of, 165
new work on the history of, 24
"Chemistry for Schools," (review), 10
Chemists' and mineralogists' travelling companion, 288
Chevalet, M., sewage of Paris, 59
Chevrier, M., action of chlorosulphide of phosphorus on alcohol, 88
Chestnut, dextrine in the, 24
Chili, minerals in, 192
Chloraceten, 203
Chloral, action of on aniline, 287
hydrate of, 46
preparation and properties of, 22, 167, 227
testing of, 179
manufacture and utilisation of products, 214
Chloral-hydrate, 76
transformation of into chloroform, 82
Chlorate of potassium and nitric acid, as an oxidising mixture, 195
Chlorcumarine, 275
Chlorine, action of on alcohol, 94
aldehyde, 286
estimation of, 264
and Eaux-de-Javelle liquors, titration of, 215
Chlorine and oxygen, heat evolved when boron combines with, 70
and oxygen, heat evolved when silicium combines with, 82
dry, action of on dried nitrate of silver, 46
gas, gold refining by, 229, 241
in waters, estimation of, 217, 237
reaction of on sulphur salts, 121
Chlormaleinic acid, formation of from benzol, 239
Chloro-chromic acid, action of on benzol, 12
aromatic hydrocarbons, 23
Chloro-phenol-sulpho acid, 70
Chloro-nitro-phenols, 352
Chlorophyl globules under the influence of light, 45
Christie, J., history of madder, 67
Chrysophanic acid, 12
Chrome colour, 264, 276
Chromium in chrome-iron ores, 266
salts, of, experiments with, 143, 274
Church, A. H., analyses of two Cornish minerals, 223
Chuteaux, Dr., bichromate battery, 238
Ciment lapidifique hydrofuge, 251
Cinchona bark from Java, 238
value of, 178
trees in island of Réunion, acclimatisation of the, 22
Cinnamic acid, 286
synthesis of an acid homologous with, 191
Cities and towns, number of inhabitants of, 191
Citric acid, 155
Clapham, R. C., manufacturing caustic soda, 148
Clark, Dr., estimation of iodine and bromine in the mother liquors from saltpetre and in kelp, 44
Clark, F. W., separation of tin from antimony, arsenic, and molybdenum, 124
Classen, Dr. A., precipitation and estimation of manganese by sulphide of ammonium, 166
Clemm, C., haloid compounds and their derivatives, 142
Clermont, M., aceto-chlorhydrine from octyl-glycol, 58
Clermont, P. de, octylic compounds, 215
Cloëz, S., acclimatisation of the Eucalyptus globulus, 264
chemical research on eucalyptol, 166
rendering commercial disulphide of carbon inodorous, 22
Coal, changes it undergoes by exposure to air, 168
discovery of in Algeria and Turkey, 35
dry, carbonisation of, 119
dust, substances to agglutinate, 71
exposed to air, 192
gas at Munich, bicarbonate of ammonium in the, 227
estimation of disulphide of carbon in, 95
sulphur in, 204
in the Brazil, 119
non-caking, carbonisation of, 120
steam-generating power of, 264
tar, products of distillation of, 203
Coals of Upper Silesia, 192
Cobalt and manganese and alloys with copper, 154
and nickel, new locality of, 237
xantho, roseo-cobalt, and purpureo-cobalt, researches on, 106
Cochineal, adulteration of, 131
Coffee-roasting machine, improved, 131
Coin, ancient Bactrian, composition of, 238
Coke, from peat, technical application of, 84
Cold, effects of on plants, 300
Collas, C., crystallisation of diamond, rock-crystals and tribasic phosphate of lime by means of cold, 72
iron obtained by electric current, 274
Colley, A., action of free haloids, 119
Collidine, formation of, 227
Collieries near Miesbach, 167
Colophonic hydrate, 56
Colorimeter, Duboscq's new, 32
Colorimetric carbon test of Eggertz, 131
Colours and pigments, 84, 120
theory of, 238, 286
Combustion, lecture experiment to show the increase of weight caused by, 23
spontaneous, 119
Comets, shape of, 275
Commaille, Dr. A., experiments on the salts of manganese, 300
experiments with salts of chromium, 143
Conducting wire, closed, curved, and ramified, oscillatory electric discharges in, 287
Contaret, M., artificial digestion of amylaceous matter by aid of maltine, 119
Copper and arsenic, separation and estimation of, 133
and brass, coating cast-iron objects by electrolysis with, 246
chemistry of, 28, 202, 219
cobalt and manganese and their alloys with, 153
commercial, selenium in, 178
depositing on cast-iron, 47
dichloride of, determination of iron with, 235
extraction, 264
of from its ores, 300
iodo-mercurate of, 227
oxide of, action of ammoniacal salts on, 154
process, humid, 177
salts, in presence of cyanogen compounds, reactions of, 95
volumetrical estimation of, 226
Corn, analysis of, 299
straw, wax of, 23
Cornish minerals, analyses of two, 223
Coralline, water-glass as a solvent for, 239
Corona, supposed polarisation of the, 17
Correlation of vital and physical forces, 56
Cosmography, handbook of, 130
Cossa, M., mineralogical formula of carbonates, 70
Coumarin, bromine derivatives of, 247
Coumbray, M., fall of a meteorite at Mourzouk, 154
Coupier, M., aniline red free from arsenic, 35
Credner, B., salicylic aldehyde with primary monamides, 108
sulpho-fumaric acid, 108
Cresol, ethers of, 46
solid, 250
Cresylo-purpuric acid, 46
Croton oil, non-volatile acids of, 34
Crotonic acid, solid, 203
Cruciferæ, seeds of, fatty oils from, 47
Crystals, fluids in, 213
Cuba, population of, 59
Cupric aceto-arsenite, homologues of, 265
Currents, electric, variable state of, 57
Cyanamide, some derivatives of, 287
Cyanhydric acid in tobacco smoke, search for, 167
Cyanic and cyanuric ethers, 274
Cyanides and prussiates, application of wool-suint to preparation of, 72
poisoning with, 130
Cyanogen, action of on anthranilic acid, 6
Cyanogen compounds, double, 46
Cyanuric acid ether, bodies isomeric with, 227, 237, 288
Cyder, apples suitable for, 71
Cymbals and tam-tams, manufacture of, 46
Cyrias, F., detection of bone-cuttings among rasped harts-horn, 300

DANCER, J. B., microscopical examination of milk, 5
Daniell electric battery, substitute for copper for the, 167
Darmstädter, L., epichlorhydrine, 58
and A. Henniger, new organic phosphorus compound, 203
new phosphated compound, 119
and Wichelhaus, MM., naphthaline, 58
Daubié, J. B. A., tinning of iron, 276
Davies, G. E., trivalent elements, 81
De Bottala, Dr., upheaving of the soil, 262
Debray, H., assay of silver which contains mercury, 201
decomposition of sesqui salts of iron, 53
solubility of chloride, bromide, and iodide of silver in salts of mercury, 226
Degelmeyer and Zacherl, MM., Bavarian, Vienna, and Belgian beers, 96
De Keyer, M., oil refining, 120
Delaporte, M., oxyhydrogen blowpipe, 264
Delaurier, M., thermo-electricity, 82
universal galvanic battery, 47
De Luca, S., thermo-mineral water of the solfatara of the Pouzzoles, 119
Demazat, Dr., electro-magnetic apparatus, 264
Denza, Rev. P., rain of sand, 130
Descamps, M., metallic tartrates, 190
Descartes, the teacher of, 178, 274
Des Cloizeaux, M., optical properties of benzyl, 286
Desnoyers, J., and H. St. C. Deville, analysis of and useful applications of gaize, 153
Deville, H. Sainte-Claire, action of water on iron, 262
action of water on iron, and of hydrogen on the oxide of iron, 285
and J. Desnoyers, analysis of and useful application of gaize, 153
Dewilde, P., composition of ancient Bactrian coin, 238
Dextrine in the chestnut, 24
insoluble in water, 201
Diabenzoic acid, 216
Diamines derived from α and β dinitronaphthalines, 106
Diamond, crystallisation of, 72
discovery of at Dlaschkowitz, 57, 119
Diamonds, 94, 190
combustibility of, 225
Dibromacetic acid, preparation of, 239
Dibromotoluols, isomeric, 263
Dichlorhydrine, action of bromine on, 286
Dichlorobromohydrine, 82
"Dictionary of Scientific Terms" (review), 115
Didierjean, M., milk as a preservative against lead poisoning, 250
Diéterich, M., bleaching of fixed fatty oils, 36
Diethglyoxylic ether, 202
Dingler, Dr., aniline black for linen, 275
colorimetric carbon test of Eggertz, 131
fatty acids from wool and soapsuds, 131

Dinitrobenzol, 156, 168
Dioptrical notices, 35
Diphenyl-sulpho-carbamide, products of desulphuration of, 70, 251
Divers, Dr., precipitation of solutions of ammonium-carbonate, sodium-carbonate, and ammonium-carbamate by calcium chloride, 247
Doer, W. H., action of zinc dust on naphthylamine, 227
Dome of the Capitol at Washington, movement of, 299
"Domestic Fire-places" (review), 55
Domeyko, M., minerals in Chili, 192
Doors, lighting numbers of by night, 11
Double decomposition, thermochemical researches on bodies formed by, 250
Draper, H. N., alleged solubility of glycerine in chloroform, 87
Dreher, E., and R. Otto, mercurodiphenyl, 275
Dreykorn, F., and E. Reichardt, colouring matter of the alder tree, 131
Dromard, E., utilisation of heather, 131
Drop black, 204
Droux, L., soap and soap-making, 107
Dualine, 275
Dubrunfaut, J., expansion of gases, 178
Dupuis, M., elucidating remarks on M. Charles, 129
Dupré, A., estimation of three kinds of sugar in one solution, 97
presence of lead in wine, 33
Dusart, Dr. F., experiments on the physiological and therapeutical properties of phosphate of lime, 299
Dye-stuffs, preparation of the extracts from, 179
Dye-woods, extracts from, 215
Dynamite manufactory, explosion of a, 94

EGGERTZ, M., estimation of sulphur in cast-iron and steel, 10
Eggs, preservation of, 227
Electric action of points, 180
clockwork, 143, 275
condensers, theory of, 274
current, molecular groups decomposed by, 59
iron obtained by, 274
currents, 214, 238, 274
physiological action of, 299
produced by contact of metals and water, 225
lantern, improved, 56
light regulator, improved, 238
machine, conversion of into a Holtz's machine, 200
poles of the, peculiar form of the discharge of, 299
measurements, 240
phenomena, 179
and theories, 210, 247
spark, producing by figures similar to those of Lichtenberg, 298
sparks, 214, 238
Electricity, amelioration of wines by, 57, 142
applied to registering vibrations, 84
Electro-capillary currents in bones, nerves, and brain, 118
Electro-dynamic action, theory of, 179
Electrolytic experiments, 238
Electrolysis of organic alkalies, 59
of some chemical compounds, 227
Electro-magnetic apparatus, 94, 264
Electro-motive force of divers substances, 129
effect heat exercises on, 60
Electro-motive force, weak, estimation of, 46
Electro-plating with iron, 84
Electroscopic experiments, cause of error in, 206
Elementary bodies, isomerism of the, 288
"Elementary Chemistry" (review), 9
Elkington, J., copper extraction, 264
Eller, M., naphthol and carbonaphtholic acid, 58
Elsasze, the, during the tertiary period, 131
Emmerling and Baeyer, MM., synthesis of indol, 70
Endosmosis, nature of, 154
Englehardt and Latschinoff, MM., nitro compounds, 262
preparation of kresotinic acid from xylol, 24
Epichlorhydrine, 58, 216
Equilibrium figures of liquid mass, 274
Erecting prism, 264
Ertel, Dr. W., arsenic-free and arsenic-containing aniline colours, 179
Ether, acetic, action of sodium on, 113
successive action of iodide of ethyl and sodium on, 7
as an intoxicant, 92
nitrous, and bicarbonate of potassa, 144
water in, phenylate of potassa as a test for, 166
Ethylbenzol, action of bromine on, 52
Ethyl, iodide of and sodium, action of on acetic ether, 7
Ethylamines, preparation of on the large scale, 203, 251
Ethylen and propylen, monobromated, iodhydrates and chlorhydrates of, 201
Ethyloxybenzoic acid, 191
Eucalyptol, chemical research on, 166
Eucalyptus globulus, acclimatisation of the, 264
Evers, J. C., measures and weights of metrical system, 252
"Examination of Petroleum and other Mineral Oils according to the Petroleum Act, 1868" (review), 10
Excreta of towns, treating, 128

FABRICS, removal of iron-mould from, 300
Fairfax's test-papers, 252
Fatty acids from wool and soap-suds, 131
Faust and Saame, MM., derivatives of naphthalin, 24
Feil, M., heavy flint glass for optical purposes, 22
Feltz, M., black snow, 191
Felz, Dr., saccharate of hydrocarbonate of lime, 240
Fermentation, 82, 180, 294
and small organisms, 288
Field, F., double arseniate of magnesia and ammonia, 193
Figures, dispersion, experiments on, 60
Fino, Dr., peat from Avigliana, 95
Fire-clay stoves, 262
Fire-clays, 71
"First Lessons in Organic Chemistry" (review), 128
Fir-tree, large, 131
Fisher's salt, 252
Fittig, R., and P. Jannasch, tetramethyl-benzol, 202
and J. Remsen, constitution of piperic acid, 154
and H. E. Storrs, isophthalic acid, 191
Flame, formation of ozone in, 299
temperatures, investigation of, 281
Flames, temperature of, 120
and heating powers of, 291
Flax, chemical treatment of, 264
Fleck, Dr., estimation of nitric acid in waters, 94
Flint-glass, heavy, for optical purposes, 22
Fleury, G., products of the Boletus laricis, 167
two products from the white Agaricus, 45
Flower farms, 92
Flour, self-raising, 252, 276
Fluids, calorific capacity, 276
drop apparatus for, 10
Fontaine, M., steam-engine for domestic use, 240
Forces, measurement of, 130
Forest, submarine, 240
Formic acid from carbonic acid, 178
lead-salts of, 94
glycolic, uvic, and glyoxylic acids, 58
Fossil bones, 226, 263
France, departments of, scientific work done in the, 251
Franz, B., zirconium, 190
Freezing water, bursting projectiles by, 273
Fremy, E., nitrous acid, 45
reduction of nitrous acid by metals, 286
Fresenius, Dr. R., quantitative estimation of carbon in pig-iron, 167
Friedel and Ladenburg, MM., ethylic series of silicium, 181
Fuchs, M., ethers of cresol, 46
Fuel, means of saving, 35
pulverulent and wet, combustion of, 192
Furnace for burning bricks, 264
to burn spent tan, 10

GAIFFE, M., depositing nickel on other metals, 57, 69
Gaize, analysis and useful applications of, 153
Gal, H., and J. Gay-Lussac, compounds homologous with tartaric and malic acids, 274
Galvanic batteries, 59
battery, constant acting with one liquid, 214
element with three fluids, 93
Galvanometer, vertical beam, 153
Galvanoscopic lantern, 90
Garrick, A. R., sulpho-acids of benzol, 242
Gas analyses, avoiding observations of temperature and pressure in, 299
coal, valuation of, 228, 240
flame, 238
for heating purposes, 35
furnace, 216, 227, 252
illuminating, bicarbonate of ammonia in, 192
meters, inspection and testing, 167
nitrogen, present in oxygen or air of, 45
of the Fontaine Ardente of St. Barthélemy, composition of the, 250
periodical evolution of in the protoplasma of the living Arcellæ, 47
purifiers, revivification of the oxides of iron employed in by means of steam, 215
quality of supplied to the metropolis, 177
regulator, 120
sulphuretted hydrogen apparatus, 167
Gasfittings, 192
Gas-well, examination of, 299
Gases, action of magnetism on, 45
and vapours, action of light on, 90
carburetted, action of on charcoal, 153
compressibility of, 262
containing oxychloride of carbon, analyses of, 107
Gases, expansion of, 178
in arable soil, 47
rarefied, action of magnetism on, 70
colours exhibited by in spectrum analysis, 129
simple, spectra of the, 57
solution of by molten iron, &c., 119
specific heat of, 70
through pipes, motion of permanent, 214
Gaudin, M., artificial production of precious stones, 22, 45
Gautier, A., action of perchloride of phosphorus on iodoform, 250
Gay-Lussac, J., and H. Gal, compounds homologous with tartaric and malic acids, 274
Gelsemium sempervirens, chemical composition of, 83
Genz, M., xylidine derivatives, 70
Geological and agronomical map of the Département de la Haute-Vienne, 94
microzymas of different origin, 214
"Geologie Comparée: Etude Mineralogique du fer Météorique de Deesa" (review), 33
Geology, letters on, 24
Georges, J., cause of steam-boiler explosions, 191
Gerlach, Dr. G. T., specific gravities of solutions, 155
German towns, water supply and water-works of, 252
Genus Equus, species of, 59
Gibbins, H. B., manufacture of sulphuric acid, 132
Gibbs, W., researches on xantho-cobalt, roseo-cobalt, and purpureo-cobalt, 106
Gibsone, B. W., ozone and sulphurous acid, 297
Gilding, pyro-electric, 179
Gintl, W. F., ratanhine and its combinations, 180
Girard, A., hydrogenated derivatives of disulphide of carbon, 154
J., colouration of water of Mediterranean, 276
Glacial acetic acid, quantitative estimation of, 286
Glaciers, ancient, 238
descent of, 277, 292
Gladstone, Dr., analysis of water, 261
refraction equivalents, 114, 173
Glaucopyrite, 251
Glass and porcelain, action of solutions on, 167
colouration of, 180
flint, refraction and dispersion of, 47
Globe, form of, 119, 142
Groves and Bolas, MM., tetrabromide of carbon, 223
Glue, testing, 264
Glutz, L., persulphocyanic acid and pseudo-sulphocyanogen, 239
sulpho-cyanogen compounds, 216
Glycerine, 156, 168
chloro-nitric and bromo-nitric ethers of, 201
compounds, 239
derivatives from, 227
detection of butyric acid in, 58
in chloroform, alleged solubility of, 87
Glycogen, products of decomposition of by sulphuric acid, 263
Glycol and octylic compounds, 287
Glycolic, uvic, formic, and glyoxylic acids, 58
Glyoxylic, glycolic, uvic, and formic acids, 58
Gmelin's chemistry, 21, 33, 44
Gold and its compounds, 201
and silver, assays of, 246
coins, sweating, 69
found in the rivers of the Scandinavian Peninsula, 58

Gold, fulminating, explosion of, 172, 240
refining by chlorine gas, 229,241
Goppelsroeder, Dr., estimation of nitric acid in waters, 251
Gore, G., fluoride of silver, 28
Gossart, Dr., sulphuretted water, 214
Gonnard, J., alunite of Mont-Dore, 214
Graduating diaphragm, 212
Graebe and Liebermann, MM., anthracen-carbonic acid, 70
products of distillation of coal-tar, 203
Graeger, N., decomposition of ammonio-phosphate of magnesia, 179
Granier, M., artificial caoutchouc, 72
Grapes, studies on, 215, 274
Graphite, estimation of lamp-black in, 108
Gréhaut, M., absorption of oxide of carbon by the lungs, 274
detection of oils from the seeds of Cruciferæ, 35
Griefswald, contributions from the chemical laboratory at, 34
Griess, P., action of cyanogen on anthranilic acid, 6
Grimaux, E., and J. Ruothe, MM., essence of sassafras, 21
Groves, C. E., tetrabromide of carbon, 236, 296
Gruber and Otto, MM., sulpho-toluide, 59
Gruner, L., mechanical properties of steel containing phosphorus, 142, 276
Guaiacum copper reaction, researches on the, 106
Guanidine, derivatives of, 106
Guanidines, tri-substituted, 106, 108
Guillotine, capital punishment by, 130
Gutta-percha vessels for chemical uses, 84
Guy, W., subliming temperatures of poisonous substances, 240
Guyon, M., observation made by laundresses on the south coast of Spain, 250
Guyot, M., toxicological properties of some rosolates, 45
palm oils of commerce, 300
Gypsum, removing from water, 70

HÆMOGLOBINE, products of decomposition of, 203
Hail, 262
Hailstorm, 298
Haiti, atmospheric electricity of, 71
Halle and Co., MM., soluble iodine green, 71
Hallstadt, a new salt from, 94
Hallwachs, Dr. W., adulteration of saffron, 79
Hallwachs, F., amidodicyanic acid, 191
Halogens, oxygen compounds of the, 11
Haloid compounds and their derivatives, 142, 203
Haloids, free action of, 119
Hamilton, H. B., determination of sulphur in iron, 147
Hann, Dr., decrease of temperature of air, 167
Hansen, C., ethyl combinations of thallium, 106
Hartley, W. N., atom-fixing and atom-displacing powers, 109, 145
monad elements, 93
Harz, M., fatty oil contained in olives, 35
Hausofer, Dr., meteoric iron of Collina di Brianza, 12
meteorite found near Cranbourne, Australia, 12
Hautefeuille and Troost, MM., heat evolved when boron combines with chlorine and oxygen, 70
Hautefuille and Troost, MM., heat evolved when silicium combines with chlorine and oxygen, 82
Haute-Savoie, climate of, 276
Havrez, M., application of wool suint to preparation of prussiates and cyanides, 71
Hayes, A. A., colour of water of Lake Leman, 282
lignites of middle and southern Italy, 157
Heat, application of to mechanical labour, 84
disengaged by the combination of boron and silicium with chlorine and oxygen, 227
influence of on the elasticity of caoutchouc, 239
latent and sensible, 192
mechanical equivalent of, 298
radiated at low temperatures, emission, absorption, and reflection of, 286
radiation of from the moon, 94
reflection of, 177
Heather, utilisation of, 131
Heidelberg, University of, 95
Heintz, M., uvic, formic, glycolic, and glyoxylic acids, 58
Heisch, Dr., organic matter in water, 295
Henniger, A., and L. Darmstädter, new organic phosphorus compound, 203
Henry, L., chloronitric and bromonitric ethers of glycerine, 201
combination of chloride of phosphorus with sulphur, 23
ethereal derivatives of acids and alcohols, 70
ethereal derivatives of the polyvalent acids and alcohols, 24
sulphocyanides of the alcohol radicals, 23
transparency of sulphide of lead, 239
tribromhydrine, 154
Herman, W. D., determination of carbon in steel, 295
Hermes, O., crystallised hydrate of soda, 203
Herse, O., bases in opium, 82
paytine, 203
Hewett, D. B., manufacture of sulphuric acid, 200
Hickey, W. R. G., treating excreta of towns, 128
High pressure, working under, 213
Hildwin, Dr., preparation of liquid iron soap, 238
Hlasiwetz, J., caffeic acid, 143
Hofler, L., condensed milk, 252
Hofmann, Dr., action of iodine on thiobenzamide, 23
banquet to, 83
history of urea, 131
preparation of ethylamines on the large scale, 203
Hofmann, M., manufacture of sulphuric acid, 106, 164
Hoh, T., lightning without thunder, 11
Holbein, F., preservation of zoological and anatomical preparations, 190
Holtz electrical machine, 82, 120, 226, 240, 286
Honeysuckle, berries of the, poisoning with the, 131
Horn, picric acid for imparting red colour to, 226
Houzeau, A., absence of oxygenated water in the snow fallen at Rouen, 129
electrolysation of oxygen or air as a means of producing ozone, 298
ozone, 118
Human system, effects of climbing high mountains on, 59
Hummel and Bolley, MM., phenyl-brown, 59
Hundsrück, mineral lodes of, 262
Hunt, T. S., chemistry of copper, 219
Hunter, J., M.A., absorption of mixed vapours by charcoal, 43
Hurlstone, A. P., obituary notice of, 45
Hutton, W. R., mineral phosphates used in making superphosphates of lime, 150
Hydrates, baric and calcic, reactions of disulphide of carbon with, 56, 81
Hydracids, combination of with bromated ethylen and propylen, 119
Hydride, salicylic acids from, 252
Hydriodic and hydrobromic acids, specific gravity, percentage, and composition of at various temperatures, 286
Hydrobromic acid, action of on azoxybenzide, 299
hydrated, preparation of, 286
and hydriodic acids, specific gravity, percentage, and composition of at various temperatures, 286
Hydrocarbonate, saccharate of, 215
Hydrocarbons, aromatic, action of chloro-chromic acid on, 23
and their derivatives, refraction equivalents of the, 173
oxidation of, 274
Hydrochloric acid, action of on nitrobenzol, 34
action of on osseine, 274
Hydrocyanic acid and cyanides, poisoning with, 130
Hydrosulphuric acid, basicity and rational formulæ of, 203
Hydrogen, action of on perchloride of methan, 252
action of on the oxide of iron and of water on iron, 285
carbides of, action of oxychloride of carbon on, 107
carbon and oxygen, chemical equilibrium between, 143, 169, 214
metallic, 218
persulphide of, 300
sulphuretted, action of on manganese compounds, 192
action of on peroxide of iron, 46
formation of from water and sulphur, 120
Hydrogenium amalgam, 287
and ammonium amalgam, 265
Hydrometer, Baumé's, 144, 156
Hydrosulphuric acid, synthesis of, 46
Hydroxylamine, synthesis of, 24, 94
Hygrometer acting by absorption, 274
Hypersthene, crystalline form of, 179
Hypochloric acid with brucine and its salts, behaviour of, 167
Hypogallic acid, oxysalicylic acid, and iodated salicylic acids 132
Hyposulphates, 179
Hyposulphite, action of iodine on, 103, 141, 164
Hypophosphoric acid, use of in agriculture, 59

ICE, latent heat of, 214, 225
in India, artificial production of, 215
Ice-making, Carré's apparatus for, 144
machine and cooling apparatus for brewer's wort, 288
Ice, manufacture of, 192
Icicles, formation of, 129
Images, accidental, 93
Imperial Agricultural College, 191
Observatory at Paris, 83, 94
India, artificial production of ice in, 215
Indigo-carmine, 240, 252
Indol, synthesis of, 70
Inks sympathetic, 240
"Introduction to the Study of Chemistry" (review), 128
Inuline, 71, 131
Iodic acid, 154, 214, 250
Iodides, 203
Iodine, action of on hyposulphite, 103, 141, 164
action of on thiobenzamide, 23
and bromine in mother liquors, the estimation of, 44
green, soluble, 71
recovering from iodide of mercury, 46
terchloride of, 106
vapours, absorption spectrum of, 238
volumetric assay of, 143
Iodoform, action of perchloride of phosphorus on, 250
formation of, 252
Irish Sea, composition of the water of the, 182
Iron, action of water on, 262
action of water on, and of hydrogen on the oxide of, 285
analysis of, 71
and alumina, separation of, 54
and cast-iron, so-called cold galvanisation of, 288
and potassium, double sulphide of, 285
and steel, estimation of carbon in, 120
and steel, estimation of sulphur in, 10
and zirconium, separation of titanic acid from, 120
basic salt of, 144
carburets of, cause of the "rochage" of, 298
cast, depositing copper on, 47
manufacture of, 275
coating with copper and brass, 273
determination of sulphur in, 147
determination of with dichloride of copper, 235
estimation of in the state of peroxide by means of hyposulphite of soda, 47
electro-plating with, 84
Franklin County meteoric, description and analysis of, 298
galvanically-precipitated, 179
in chrome-iron ores, 266
magnetism of, influence of musical vibrations on the, 238
manufacture of, 96
meteoric of Breitenbach, enstatite occurring in, 179
neutral perchloride of, preparation of, 143
nitrate of, 166
oxidation of, 119
oxides employed in gas purifiers, revivification of by means of steam, 215
peroxide of, action of sulphurretted hydrogen on, 46
pig, quantitative estimation of carbon in, 167
rust, composition of, 42
sesquisalts of, decomposition of, 53
solid, floating of on the molten metal, 287
sulphuret of, action of the air on, 46
tinning, 276
Isambert, F., dissociation of ammoniacal compounds, 119
Isatine, isatinic acid, and indol, constitution of, 95
Isinglass, Indian and China, 132
Isobutyl-alcohol, conversion of into tertiary pseudobutyl alcohol, 34
trimethyl carbinol from, 263
Isomeric nitro-bromotoluols and bromotoluidine, 202
toluol-sulpho acids, 286
Isomorphism of various bodies, 216
Isophthalic acid, 191
Isopropyl, phenate of, 107
Italy, middle and southern, lignites of, 157
Ivory, picric acid for imparting red colour to, 226

JAMIN and Amaury, Drs., specific heat of mixtures of alcohol and water, 298

Parachlorotoluidine, 46
Paraffin, products of the oxidation of, 203
Paratoluidine and bromotoluol, 46, 107
Paris basin in pre-historic days, 250
discovery of ancient monument of, 215
observatory at, 59
sewage of, 59
Parkes, E. A., and Count C. Wollowicz, effect of alcohol on the human body, 253
Parnell, E. W., double arseniate of magnesia and ammonia, 213
separation and estimation of copper and arsenic, 133
of iron and alumina, 54
Patterson, T. L., obtaining a continuous current of air or gas under pressure, 173
Pattinson, J., chromium and iron in chrome-iron ores, 266
English commercial soda test, 285
Paul, B. H., testing of manganese ores, 16
testing mineral oils for lamps, 2
Paytine, 203
Pazschke, Dr. F. O., epichlorhydrine, 216
Peat from Avigliana, 95
improving, 168
Pellet and Champion, MM., preparation of bromhydric acid, 154, 226
Pendulum motion, complicated, 238
Péricot, E., and T. Appolt, carbonisation of dry coal, 119
Perkin, W. H., artificial alizarine, 139
bromine derivatives of coumarin, 247
Pernod, M., obtaining oxalic acid from madder, 192
Personne, M., preparation and properties of hydrate of chloral, 22
Persulphocyanic acid and pseudosulphocyanogen, 239, 287
aniline, 275
Perutz, M., detection of butyric acid in glycerine, 58
Petrieff, W., a body homologous with benzidine, 299
action of nitric acid on azotoluidide, 299
azoxytoluidide, 35
Petroleum gas, production of, 227
in the United States, production of, 202
origin of, 155
testing, 85
Pettenkofer's respiration apparatus, source of error occasioned by the use of, 286
Peruvian guano, 154
Pfaundler, L., dissociation of fluid sulphuric acid, 107
"Pharmacopœias of the London hospitals" (review), 55
Phenaconic and maleanic acids, 239
Phenic acid, application of for the purposes of leather and skin manufacture, 300
series, poisonous property of, 202
Phenol, carbonate of, 23
chlorocarbonate and carbaminate of, 95
dichloride of dichloronitrophenol and dichloramidophenol, 252
reaction of on ammonia, 250
sulpho-acids of, salts derived from, 60
synthesis of, 274
Phenyl-acetic acid, 203
Phenyl brown, 59
ether, 216
Phenylsulphopropionic acid, 275
Philipp, J., terchloride of iodine, 106
Phillips, M., alkaline lakes in California, 83
Phillips, S. E., new sulpho compounds, 122
Phipson, Dr., mineral from San Paolo, 13
potash in chromate of lead, 253
Phosphate of lime, 276
Phosphated compound, 119
Phosphates, native crystalline, 168
Phosphatic raw materials, sampling cargoes of, 21
Phosphoric acid, determination of, 170
estimation of as ammonio-phosphate of magnesia, 205
estimation, utilisation of molybdic acid from residues of, 166
Phosphorus, amorphous, for safety matches, 168
black, 201
cause of the emission of light by, 190
chloride of, combination with sulphur, 23
chlorosulphide of, action of on alcohol, 88
compound, new organic, 203
mechanical properties of steel containing, 142, 276
perchloride of, action of on iodoform, 250
Phosphuretted bases, new platinic compounds derived from, 214
Photographic figures, preparation of on glass, 180
plane-table, 54
Photometer, improved, 83
Photometric experiments, 202
Physical condition of bodies, 119
phenomena observed during the bursting of hollow cast-iron projectiles, 298
Physics, molecular and cosmical, principles of, 96
Pichon, M., red lead from nitrite of lead, 264
Picric acid and dinitrophenol, haloid compounds which correspond to, 251
for imparting a red colour to ivory, bone, and horn, 226
Pickering, Prof., supposed polarisation of the corona, 19
Pierre, M., presence of soda and potassa in divers parts of plants, 22
J., and E. Puchot, propylic, butylic, and amylic aldehydes, 119
Pig-iron, wrought-iron, and steel, manufacture of, 96
Pigments, arsenical green, dangers of, 94
Pinner, A., and G. Krämer, action of chlorine on aldehyde, 286
products obtained from crude malt spirits, 190
Piperic acid, constitution of, 154
Pisani, F., minerals found in the Cap Garonne copper mine, 226
Plants, effects of cold on, 300
electricity of, 239
herbaceous, metamorphosis and migrations of the immediate principles in, 22
presence of soda and potassa in divers parts of, 22
Plateau, J., equilibrium figure of a liquid mass, 179
Platino-cyanides, colouration exhibited by some of the, 106
Platinum ammonia compounds, 269, 289
bases, 203
new series of double chlorides, belonging to the, 24
electromotive force of, 129
fusion of, 94
light, 35
metals, separation of the, 39
protochloride of, and oxide of carbon, 262
and triethyl-phosphine, 225
researches on, 298
Pneumodensimeter, 144
"Pocket Guide to the British Pharmacopœia" (review), 55
Poggiale and Marty, Drs., search for cyanhydric acid in tobacco smoke, 167
Poisoning, detection of cyanhydric acid and cyanides in cases of, 22
Poisonous substances, subliming temperatures of some, 240
Polaristrobometer, M. Wild's, 35
Polefroy, M., tanning by means of carbonic acid, 288
Pollacci, E., manganese in blood and milk, 274
Poly-bromides and tetrammonium bases, 227
Porter, E., magnetic phenomena, 164
Porphyry, artificial, 35
Potash, action of on sulphuric derivatives of hydrocarbons, 274
and soda, presence of in divers parts of plants, 22
bicarbonate of and spirit of nitrous ether, 144
bisulphate of, compound of essential oil of mustard with, 275
in chromate of lead, 253
plate sulphate of, 150
Potassa, permanganate of, action of on quinine, 132
phenylate of, a test for water in ether, 166
silicate of, application of for solidifying fossil bones, 250
trithionate and seleno-trithionate of, crystalline forms of, 180
Potassium and iron, double sulphide of, 285
bromide of, 82
mixed with chloride, estimation of, 143
chlorate of and nitric acid, as an oxidising mixture, 195
ferricyanide of, preparation of, 71
Potatoes, machine for peeling, 215
solanine in, 216
Pouzzoles, solfatara of, thermo-mineral water of the, 119
Prat, J. P., on gold and its compounds, 201
Printing apparatus, stenographic, 83
Prior, E., composition of carbonates of manganese, 167
"Private Life of Galileo" (review), 151
Procter, W., jun., assay of American opium, 144
Propan, derivatives of, 11
Propionyl, chloride and iodide of, 215
Proto combinations, molecular weight of some, 70
Prudhomme, M., action of sulphuric anhydride on proto and sesquichloride of carbon, 262
Pseudosulphocyanogen, 275
and persulphocyanic acid, 239
Public instruction, ministry of, 263
Pump, centrifugal, 289
Pumpkin seeds, 263
Pumps, arrangement of, 70
Puscher, C., coating brass with bismuth, 168
water glass as a solvent for coralline, 239
Pyro-electric gilding, 204
Pyrometer, electrical, 72
improved, 168
Pyro-tartaric acid, fermentation of, 226
preparation of, 226, 274

QUANTITATIVE analysis, new work on, 297
Quekett Microscopical Club, 127
Quenault, Dr., submarine forest, 240
Quinine, action of permanganate of potassa on, 132
light sulphate of, 263

RABIES, cases of, 178
Radan, R., influence of the motion of a source of sound or light upon the sound or light emitted from the object in motion, 288
Rademaker, Dr., reaction between nitrous ether and bicarbonate of potassa, 144
Radziszewski, M., wax of corn straw, 23
phenyl acetic acid, 203
Rag-washing machine, 251
Railway from Arequipa to Puno and Cusco, 47
Rain, peculiar, 251
Rainfall in France, 276
Rammelsberg, C., combination of tantalum and niobium, 12
composition of tourmalines, 238
thallium, 239
Ramsbosson, M. E., diamonds, 94
Ransome, Dr. A., organic matter of human breath in health and disease, 127
Raoult, F. M., composition of the gas of the Fontaine Ardente of St. Barthélemy, 250
Rapakiwi for the manufacture of bottle-glass, 168
Rasped hartshorn, detection of bone-cuttings among, 300
Ratanhine and its combinations, 180
Rath, M. von, mineralogical researches, 60
Rathke, Dr. B., selenium, 180
Rays observed in the solar spectrum, displacement of, 286
Raue, E. A., Catalpa bignonoides, 263
Rectification of some dates relating to the Rev. M. Grandilon's life, 286
Red lead from nitrite of lead, 264
Redtenbacher, Dr., death of, 129
Refraction, astronomical, 84
equivalents, 114
of aromatic hydrocarbons and derivatives, 173
of water, 225
Registering apparatus, 47
Reichardt, E., and F. Dreyhorn, chemical constitution of the colouring matter of the alder tree, 131
Reichardt, M., estimation of sulphur and gypsum in animal charcoal, 35
preparation of ferricyanide of potassium, 71
Reindel, M., remarks on the labours of, 154
Reinsch, Dr., artificial kirschwasser, 71
chemical constituents of asparagus berries, 216
rendering wood difficultly combustible and preserving, 239
Remsen, J., and R. Fittig, constitution of piperic acid, 154
"Reports on the Progress of Practical and Scientific Medicine in different parts of the World" (review), 104
Residues and offal, use of for agricultural purposes, 96
Resin, dissolving in water, 12
Rhine, displacement of the bed of the, 24
Rice-meal, adulteration of, 155
Richter, M., analysis of coals, 71
Rider vertical engine, 239
Riecker, M., arsenic in rosaniline, 70
arrangement of pumps, 70
removing gypsum from water, 70
Riemann, W., albolith, 167
Ritter, E., new pigment in bile, 227

River Croult, insalubrity of the water of, 286
"Rivers, Preventing the Pollution of" (review), 163, 174, 187
Rochleder, Dr., chrysophanic acid, 12
substances met with in the bark and leaves of Cerasus acida, 34
Rock-crystal, crystallisation of, 72
Rodwell, G. F., the "weapon salve" of Paracelsus, 136
Roessler, A. R., nickel linnæite, 218
tellurium in the United States, 84
Rolland and Schlœsing, MM., manufacture of carbonate of soda, 154
Romei, J., phenylate of potassa as a test for the presence of water in ether, 166
Roque, V., so-called cold galvanisation of iron and cast-iron, 288
Rosaniline, arsenic in, 70
Roscoe, H. E., artificial alizarine, 185
and T. E. Thorpe, sun's altitude and the chemical intensity of total daylight, 169
on vanadium, 183, 199
Rosenstiehl, M., formation of isomeric substances, 82
Rother, B., solution of citrate of magnesia, 144
Rosolates, toxicological properties of some, 45
Rossetti, F., maximum density and freezing of alcohol and water, 250
Rossi, M., synthesis of propylic alcohol by means of ethylic alcohol, 57
Rouby, M., artificial construction of mineral springs, 83
Rousselle, A., experiments on freezing wines, 180
Roussille, Dr. J., analysis of corn, 299
Rowan, T., spectrum of the Bessemer flame, 80
Royal Society, 118, 225
Royer, M., experiments on the intrapolar currents of a Grove element, 57
formic acid from carbonic acid, 178
Rüdorff, F., bicarbonate of ammonia in illuminating gas, 192
expansion of water, 190
quantitative estimation of glacial acetic acid, 286
Rufigallic acid, 11

SACC, Dr. J., cast-iron stoves, 59
chemically prepared bread, 287
pyrotartaric acid, 274
Saccharine juices, evaporator for, 192
matters, proximate analysis of, 86
Sadtler, S. P., potassio-cobaltic nitrite, 202
Saffron, adulteration of, 179
Salicilonitrile, 107
Salicin derivatives, researches on, 275
Salicylic acids, iodated, 252
oxysalicylic acid, and hypogallic acid, 132
aldehyde, heated with primary monamides, 108
compounds, 107
Saline solutions, refractive power of, 96
Salt, common, chemistry of, 96
volatilising, 156, 168
Salts, ammoniacal, action of on oxide of copper, 154
in solution, 250
San Paolo, mineral from, 13
Sand and blood stains, 237
rain of, 130
Sand-hill, effect of the sun's heat on a, 249
Sandberger, Dr. F., glaucopyrite, 251
Sandal-wood, researches on, 46
Santa Eulalia, silver mines of, 202
Santorin, volcano of, 82
Sassafras, essence of, 21
Saytzeff, A., University of Kasan, 154
Sciences, condition of during the middle ages, 288
Schaeffer, M., crystallised algaroth powder and oxychloride of antimony, 58
isomeric naphthols, 58
Schaller, Dr., echardonnage of wool, 264
Schafaritz, A., diamond found at Dlaschkowitz, 57, 119
Schemfil, H., fuming sulphuric acid, 276
Scheurer-Kestner, A., action of hydrochloric acid on osseine, 274
composition of fossil bones, 226
and E. Meunier, heating steam boilers, 131
Schiebler's, Dr., apparatus, 144, 156, 168
Schiel's chloral uric acid, 227
Schiff, H., ethers of boracic acid, 178
oenanthol, 108
Schinz, M., means of saving fuel, 35
platinum light, 35
Schlœsing and Rolland, MM., manufacture of carbonate of soda, 154
Schneider, R., new sulphur-salts, 60, 287
Schönn, Dr., behaviour of sodium and magnesium, 166
concentrated sulphuric acid a test for molybdic acid, 166
Schoras, M., colouration exhibited by platino-cyanides, 106
on some peculiar actions of the sun's rays, 106
Schreiber, A., diethglyoxylic ether, 202
Schultz-Sellack, modifications of sulphuric anhydride, 203
Schützenberger, M., preparation of alizarine from madder, 81
researches on platinum, 298
protochloride of platinum and oxide of carbon, 26
Schwanert and Limpricht, MM., combinations of the toluol group, 82
Science in the nineteenth century, 141
Scientific gossip, 178
men, rashness of, 105
Scintillation, 237
Scoutetten, Dr., amelioration of wines by electricity, 57, 142
Sea, movement of, 130
Sea-weed, preparation of, 251
Secchi, Rev. A., solar temperature, 130
Seely, Prof. C. A., ammonium amalgam and hydrogenium, 265
Selenic and selenious acids, preparation of, 46
Selenium and sulphur, compounds of, 180
in commercial copper, 178
Sendzink, R., action of hydrobromic acid on azoxybenzide, 299
Sepulchre and Ohresser, MM., artificial porphyry, 35
Sestini, F., composition of some metallic benzoates, 215
magnesian water from Bertinaro, 95
Sewage water, utilisation of, 238
Shafts, boring, 96
Sheet iron, pasting labels on, 216
Shellac, action of on aniline colours, 59
Shell sand from the Island of Coll, 92, 105
Sherer, E., action of iodine on hyposulphite, 141
assay of manganese ores, 284
Sidot, J., action of sulphide of carbon and carburetted gases on charcoal, 153
Sigerson, Dr., microscopic appearances obtained from special atmospheres, 296
Silica, removing, 120, 156
Silicates that do not gelatinise with chlorhydric acid, 27
Silicic acid, crystallised, preparation of by the dry way, 179
Silicium, combinations of with alcohol radicals, 179, 298
heat evolved when it combines with chlorine and oxygen, 82
ethylic series of, 181
Silico-propionic acid, 106
Silk, Yama-Mai, 59
Silliman and Wurtz, Profs., investigation of flame temperatures, 281
B., intensity of light, 96
Silva, R. D., phenate of isopropyl and some bromated derivatives, 107
Silver, chloride of, reducing, 253
chloride, iodide, and bromide of, solubility of in salts of mercury, 226
co-efficient of expansion of, 276
containing mercury, assay of, 201
dried nitrate of, action of dry chlorine on, 46
fluoride of, 28
mine, ancient, discovery of, 35
ores containing sulphurets, roasting of, 239
oxalate of, 108
Simony, Dr., a new salt from Hallstadt, 94
Skeleton pump, rotatory, 227
Smith, J. L., fall of meteoric stones near Danville, 96
E., galvanoscopic lantern, 90
R. H., manufacture of crucible steel, 15
Dr. R. A., organic matter in the air, 64, 78
Snow, double crystals of, 94
extraordinary fall of, 81
Soap, analysis of, 50
and soap-making, 107, 228
liquid iron, preparation of, 238
Soap-making, 276
Soaps, test for, 47
Soda and lime felspar, composition of, 142
and potassa, presence of in divers parts of plants, 22
carbonate of, manufacture of, 154
chlorate of, 180, 192
crystallised hydrate of, 203
hyposulphite of from alkali waste, 72
manufacture of by the use of strontia and ammonia, 36
mine, 129
Soda-test, the English commercial, 285
Sodium, action of on acetic ether, 113
action of on acetic acid, 227
and iodide of ethyl, action of on acetic ether, 7
and magnesium, behaviour of, 166
bromide of, 58, 238
Sodium-carbonate, precipitation of solutions of by calcium chloride, 247
Sodium or potassium, fusion of substances with, 166
quantivalence of, 128, 203
Soil, absorptive power of, 207, 221, 233, 255
geology of, 228
upheaving of the, 262
Solanine in potatoes, 216
Solar aureola, constitution of, 46
eclipses, 225
electricity, 83
protuberances, spectroscopic observations of the, 154
spots visible by naked eye, 94
temperature 130
Sologne, agricultural terrain of the, 214
Solutions, supersaturated, 52
Sommaruga, M. von, cresylo-purpuric acid, 46
Sonrel, L., aurora borealis, 202
Sorby, H. C., spectra of compounds of zirconia and oxides of uranium, 73
spectrum of the Bessemer flame, 79
Souberain, J. L., Indian and China isinglass, 132
Souchay, M., property of amorphous silicic acid in absorbing moisture, 155
Sound, effect of motion on, 120
figures of, 238
velocity of in water, 142
Spar, Iceland, corroded figures and asterism in, 180
Specific gravity of some saline solutions, 47
heat, determination of, 238
Spectacles, 239
Spectra, comparative scale of, 11
of compound bodies, 143
of simple bodies, 119
Spectral lines, width of, 238
Spectroscope, Browning's automatic, 200
Spectrum reactions, influence of the temperature on the sensitiveness and delicacy of, 287
Spence, P., manufacture of sulphuric acid, 141, 189
Spiller, J., analysis of water, 249
Spirits, crude malt, products from, 190
Springs, artificial construction of, 83
Spring water, organic matter in, 216
Stanford, E. C., shell-sand from the island of Coll, 92, 105
Starch, conversion of by diastase of malt, 251
estimation of in bread, 94
globules, 192
Stars, falling, 12
Steam-boiler explosions, 131, 191, 251
Steam-boilers, heating feed-water for, 130, 131
Steam-engine for domestic use, 240
Steel and cast-iron, estimation of sulphur in, 10
and iron, estimation of carbon in, 120
Bessemer and Heaton processes, 131
process for making, 69
containing phosphorus, mechanical properties of, 142, 276
crucible, manufacture of, 15
determination of carbon in, 295
Stein, Dr. W., analysis and detection of dyes and colours on textile fibres, 11
cane sugar in madder-root, 34
detection of madder colours, 275
preserved meat, 238
Steinauer, M., hydrate of bromal, 23
Stölzel, Dr. C., substitute of copper for the Daniell electric battery, 167
Stones, precious, artificial production of some, 22, 36, 45
Stoneware vessels, heating, 265
Storer, Prof. F. H., assay of galena and other compounds of lead, 137
nitric acid and chlorate of potassium as an oxidising mixture, 195
soluble lead-salt and free sulphuric acid in sherry wine, 17
Storrs, H. E., and R. Fittig, isophthalic acid, 191
Stoves, cast-iron, 59
Streit, G., and B. Franz, preparation of pure titanic acid and its separation from iron and zirconium, 120

Strehl, L., light sulphate of quinine, 263
Strontia, use of, 36
Struve, H., presence of peroxide of nitrogen in air, 156
Strychnine, antidote against poisoning with chloral, 24
detection of, 192
Stuart, Mr., separation of animal from vegetable fibre, 84
Substituted melamines, 288
Succinic acids, isomeric, 180
Suffolk, W. T., Liebig's extract, 296
microscopical manipulation, 8, 19, 29, 38, 50, 62, 88, 100, 113, 125, 136, 149, 158, 171
Sugar, crushing and making, 216
estimation of, 143
fermentation of, 47
from liquids, extracting, 226
manufactories in France, 240
manufacture of, 143, 252
optically-neutral, preparation of, 287
refinery, notes from the laboratory of a, 1, 25, 37, 49, 61
separation of ordinary from inverted, 22
three kinds of in one solution, estimation of, 97
Sugars for commercial purposes, estimation of the value of, 12
raw, cleansing, 130, 178
Suint, application of to manufacture of cyanides, 120
Sulpho-acids of benzyl, 275
Sulpho-carbolates and sulpho-carbolic acid, 144
Sulpho-carbonic extracts, 131
Sulpho-compounds, some new, 121
Sulphocyanides of the alcohol radicals, 23
Sulpho-cyanogen compounds, 191, 216
Sulpho-fumaric acid, 108
Sulpho-nitrogen acids, 59
Sulpho-urea from persulpho-cyanic acid, 275
Sulphotoluide, 59
Sulphur, aggregation of, 214
and gypsum in animal charcoal, estimation of, 35
and selenium, compounds of, 80
combination of chloride of phosphorus with, 23
in cast-iron and steel, estimation of, 10
coal-gas, 204
iron, determination of, 147
salts, new, 60, 287
reaction of chlorine on, 121
silician, 91
transformation of under influence of light, 69
Sulphuretted hydrogen, formation of water and sulphur from, 120
obtaining a regular stream of, 226
water, 214
Sulphuric acid, combination of with oxides of nitrogen, 24
concentrated, a test for molybdic acid, 166
dissociation of fluid, 107
fuming, 276
manufacture of, 106, 132, 141, 164, 189, 200, 212, 223, 224
anhydride, action of on proto- and sesquichloride of carbon, 262
modifications of, 203
Sulphurous acid, action of sunlight on, 299
and ozone, 297
Sun, nature of the, 191
spot, spectrum analysis of a, 201
Sunlight, action of on sulphurous acid, 299
Sun's altitude and the chemical intensity of total daylight, 169
rays, actions of, 106
spots, 237
Super-heated liquids, distillation of, 250
Superphosphates, mixed, coprolite and bone in, 108, 132
Synthesis of organic acids, 82
Syphon pumps and suction syphon, 83

TAM-TAMS and cymbals, manufacture of, 46
Tanning by the aid of carbolic acid, 288
Tantalum and niobium, 284
combinations of, 12
Tar as fuel in gas-works, 252
distilling, 84, 120
Tarry, H., sand and blood rains, 237
Tartar, cream of, solubility of, 167
Tartaric and malic acids, compounds homologous of, 274
Tartrates, metallic, 190
Technical education and instruction, 155
Teck, Dr. O., sugar manufacture and refining, 252
Teeth, alloy for stopping, 105
Tellurium in the United States, 84
Temperature of Central Europe during the past winter, distribution of, 228
Terephthalic acid, synthesis of, 47
Terreil, M., modifications which minerals undergo when submitted to action of saline solutions, 22
Tertiary-pseudobutyl alcohol, conversion of isobutyl-alcohol into, 34
Tessie du Motay, oxyhydrogen light, 130
tungsten blue, 130
Tetrahydrophthalic and mesohydromellitic acids, 190
Tetramethyl-benzol, 202
Tetraphenol, 191
Thallium, 239
ethyl combinations of, 106
phosphates of, 227
Theatres, application of gas illumination to, 131
Thebolactic acid, 203
Thermo-chemical researches, 59, 179, 274
Thermo-electrical apparatus with galena and iron, 59
Thermo-electricity, 82
Thermometer and pyrometer, 167
metallic, 275
new, 119
Thin fluid plates, tension of, 287
Thiobenzamide, action of iodine on, 23
Thionessal, preparation of lepiden from, 82
tollallylsulphide, lepiden, and oxylepiden, 191
Thomsen, M., preparation of selenic and selenious acid, 46
thermo-chemical researches, 59
Thomson, A. M., colophonic hydrate, 56
Thorpe, T. E., action of bromine on ethylbenzol, 52
and E. H., Morton, water of the Irish sea, 182
and H. E. Roscoe, sun's altitude and the chemical intensity of total daylight, 169
Thudichum, Dr., hydric acetate from fresh urine, 247
Thunder, lightning without, 11
Thymol, 35
Tides, theory of the, 250
Tiemann, F., derivatives of guanidine, 106
derivatives of toluylen-diamine and trinitrotoluol, 203
Tillmanns, Dr., injurious effects of impure alcohol on aniline colours, 35
Timber, beerising of, 239
processes for preserving, 84
Tin compounds, 239
foil for the preservation of perishable substances, 274
Tin in California, 225
separating from arsenic, antimony, and molybdenum, 96, 124
Tissandier, J., adulteration of catechu, 178
Tissandier, M. G., analysis and the composition of manufacturing products, 26
on soap, 50
Tissues, rendering waterproof, 95
Titanic acid, preparation of and separation from zirconium and iron, 120
Tobacco, action of smoking on the system, 36
detection of opium in, 24, 36
smoke, search for cyanhydric acid in, 167
Tollens, B., researches on the allyl group, 299
Toluol, chlorinated derivatives of, 95
group, combinations of the, 82
series, derivatives of the, 202
Toluylendiamine, 12
and trinitrotoluol, derivatives of, 203
Toluylen oxide, 286
Tomlinson, C., Brown's active molecules, 80
consecutive poles in a magnet, 193
on supersaturated solutions, 52
Tookey, assays of gold and silver, 246
Topsöe, H., preparation of hydrated hydrobromine acid, 286
specific gravity, percentage, and composition of hydriodic and hydrobromic acids at various temperatures, 286
Toselli, A., lowering the temperature of water, 298
Tourmaline, composition and constitution of, 286
Tourmalines, composition of, 238
Transparent bodies, illumination of, 129
Trécul, A., hail, 262
Trève, M., action of magnetism on gases, 45
Tribromhydrine, 154, 287, 298
Trichlorhydrine, 287
and isomeric substances, 166
Trimethyl-carbinol from isobutyl-alcohol, 263
Trinitro-toluol and toluylen diamine, derivatives of, 203
Triphenyl-guanidine, relation of to sulphide of carbon, 70
Trivalent elements, 80
Trommsdorff, Dr. H., researches in water statistics, 166
Troost and Hautefeuille, MM., heat evolved when boron combines with chlorine and oxygen, 70
heat evolved when silicium combines with chlorine and oxygen, 82
Troppmann ttial, the, 34
Tschermak, G., composition of lime and soda felspar, 142
Tungsten blue, 130, 264, 276
Tungsten, researches on, 120
Tüttschew, J., action of ammoniacal salts on oxide of copper, 154
Tyndall, Prof., action of light on vapours and gases, 90
electrical phenomena and theories, 210, 247, 259, 270

UNGER, Dr., death of, 215
Ungerer, M., manufacture of soda by the use of ammonia and strontia, 36
United States' cabinet of practical geology and mining, 84
Universities, organisation of, 226
Uranium, estimation of, 166
oxides of and zirconia, spectra of compounds of, 73
Urea, antecedents of in the animal organism, 46
compounds, 82
Urea, direct preparation of from carbonic acid and ammonia, 287
formation of, 202
Ureas, sulphuretted, 46, 131
Uric acid, 203, 216
Urine, hydric acetate from, 247
transit of alcohol into, 252
Uvic, formic, glycolic, and glyoxylic acids, 58

VALENCIENNES, A., cobalt and manganese and their alloys with copper, 153
Valerianates, estimation of valerianic acid in, 166
Valerianic acid, direct estimation of in valerianates, 166
new, 263
reduction of angelic acid to, 70
Valeric aldehyde, products of, 107
Vanadium, 183, 199
Vapour densities, the determination of, 203
Vaullet, Rev., climate of Haute Savoie, 276
Vegetable fibre, separation of animal from, 84
fibres, 262
Vegetation, critical essay on M. J. Raulin's labours on, 288
Venezuela, gold from, 84
Venus, photographic observation of passage of, 142
Vesuvine, 11
Vieth, P., solanine in potatoes, 216
Vignon and Odet, MM., action of dry chlorine on dried nitrate of silver, 46
Ville, G., the increasing expense of living, 215
quantitative estimation of sugar, 143
Violette, Ch., acidity of water collected in chloride of calcium bulbs, 178
selenium in commercial copper, 178
Vivien, J., analysis of the water of Grosmard, 264
Vogel, Dr. A., bicarbonate of ammonium in the coal-gas at Munich, 227
estimation of disulphide of carbon in coal-gas, 95
Vogl, Dr. A. E., value of cinchona bark, 178
Volpicelli, M. P., radiation of heat from the moon, 94
Von Wartha, Dr., solid disulphide of carbon, 131

WAGNER, A. action of sulphuretted hydrogen on manganese compounds, 192
action of the air on sulphuret of iron, 46
supply and quality of the water in the city of Munich, 167
Wagner's, R., chlorimetrical method, on, 155
Waldie, D., analysis of the Khettree meteorite, with an account of its fall, 277
Walenn, Mr., coating iron with copper and brass, 246, 273
Wallach, O., bromotoluen and paratoluidine, 107
Walter, T., movement of dome of the Capitol at Washington, 299
Wanklyn, J. A., action of iodide of ethyl and sodium on acetic ether, 7
action of sodium on acetic ether, 113
constitution of metallic compounds, 99
the water type, 97
Warington, R., absorptive power of soil, 207, 221, 233, 255
Warming and ventilation, 214
Wash-bottle, improved form of, 236

Water, acidity of in chloride of calcium bulbs, 178
action of on iron, 262, 285
analysis, 216, 227, 249, 261
and alcohol, specific heat of mixtures of, 298
and steam, separator for, 192
dissolving resin in, 12
estimation of chlorine in, 217, 237
expansion of, 190
freezing of, 57
glass as a solvent for coralline, 239
hardness of, 156, 168
index of the refraction of, 225
lowering the temperature of, 298
magnesian, 95
of Grosmard, analysis of, 264
of Irish Sea, composition of, 182
of Mediterranean, colouration of, 276
of the soil and of plants, evaporation of, 180
organic matter in, 295
oxygenated, absent in snow fallen at Rouen, 129
potable, 167
removing gypsum from, 70
specific heat of, 166, 201
statistics, research in, 166
supply, 299
and quality of the in the City of Munich, 167
of Brunswick and other towns, 252
variation of the index of refraction of, 201
variations of the calorific capacity of, 153
velocity of sound in, 142
withdrawal of, 190
Water-type, the, 97
Waterproof, rendering tissues, 94
Waters contained in arable soils, analysis of, 46
Waters, estimation of nitric acid in, 94
Watts, W. M., spectrum of the Bessemer flame, 80
temperature and heating powers of flames, 291
Wax of corn-straw, 23
Weidel, M., researches on sandal wood, 46
Weights and measures, decimal system of, 191
small, reduction of, 166
Weil, F., volumetrical estimation of copper, 226
Weiss-Kopp, M., depositing copper on cast-iron, 47
Weith and Merz, MM., regressive formations of the tri-substituted guanidines, 108
Weselsky, M., double cyanogen compounds, 46
Wharton, J., on two peculiar products in the nickel manufacture, 277
Wheat bread, 231
Wheatstone, Sir Chas., cause of error in electroscopic experiments, 206
White-lead, manufacture of, 126, 252
Wichelhaus and Darmstadter, MM., naphthaline, 58
base isomeric with hydrocyanide of ammonia, 105
ketonic acids, 58
zinc ethyl, 58
Widemann, C., platinised looking-glasses, 207
Willm and Caventon, Drs., lodomercurate of copper, 227
Williams, W. C., analysis of native phosphate of lead, 84
determination of phosphoric acid, 170
native gold from Venezuela, 84
Wine, estimation of acetic acid in, 167
freezing, experiments on, 180
sherry, soluble lead-salt and free sulphuric acid in, 17, 33
Wines, amelioration of by electricity, 57, 142
logwood in, 214
Winkler, Dr. C., combination of sulphuric acid with oxides of nitrogen, 24
determination of iron with dichloride of copper, 235
estimation of uranium, 166
Wolf, C., shape of our globe, 142
Wollowicz, Count, and E. A. Parkes, effect of alcohol on the human body, 253
Wonfor, W. J., acids contained in crab oil, 169
Wood, 240
difficultly-combustible, 239
Wood paper, 192
preserving, 47
Woodward, C. G., metric system, 273
Wool and soap-suds, fatty acids from, 131
bleaching of, 168
echardonnage of, 264
Wright, C. R. A., action of iodine on hyposulphite, 103, 164
Wroblevsky, E., derivatives of the toluol series, 202
isomeric dibromotoluols, 263
Wurtz, A., solid cresol, 250
synthesis of aromatic acids, 118
organic acids, 143
H., examination of a gas-well, 299
and Silliman, Profs., investigation of flame temperatures 281

XYLIDINE, derivatives of, 70, 203
Xylol, in coal-tar, 191
preparation of kresotinic acid from, 24

YARNS and woven fabrics, bleaching, 192
Young, J. W., artificial alizarine, 43

ZABEL, O., prevention of steam-boiler explosions, 251
Zacherl and Degelmeyer, MM., Bavarian, Vienna, and Belgian beers, 96
Zaliwski, M., galvanic element with three fluids, 93
Zchweskofski, M., instantaneous production of artificial precious stones, 36
Zinc and calcium, crystalline alloy of, 273
dust, action of on naphthylamine, 227
ethyl, 58
sulpho-phenate, 144
Zincke, Th., synthesis of aromatic acids, 95
and A. Kekulé, chloraceten, 203
Zirconia and the oxides of uranium, spectra of compounds of, 73
Zirconium, 190
and iron, separation of titanic acid from, 120
Ziurek, M., gas for heating purposes, 35
Zodiacal light and aurora borealis, observations on the, 82
Zoological and anatomical preparations, preservation of, 190
Zouteveen, H. H., geological formations in the Netherlands, 47
Zschiesche, M., salts of cerium metals, 264
Zurcher, Dr., effects of cold on plants, 300

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THE ELECTRO-DEPOSITION OF COPPER AND BRASS UPON IRON.

By W. H. WALENN, F.C.S.

THE early attempts to electro-coat iron with copper were unsuccessful, in consequence of all acid and neutral solutions of copper acting upon articles of iron immersed therein. This difficulty was overcome soon after Elkington's electro-silvering process was made known (in 1840) by using alkaline solutions. Alkaline sulphites, hyposulphites, cyanides, ferrocyanides, and other salts, also a mixture of these, have been used, the only salts that stood the test of time, as menstrua or solvents in which to dissolve the copper, being potassic cyanide and some combinations of this remarkable salt with ammonia and ammoniacal salts. Practical working, however, soon showed that one difficulty was overcome, but others of an important nature were introduced.

The small solubility of copper compounds in potassic cyanide, the weak action of the solution upon the anode, the small electrical conductivity of this class of metallic solutions, and the strong disposition to evolve hydrogen gas during deposition are the most important of the drawbacks to the successful working of alkaline copper solutions to coat iron. All these peculiarities have been lessened or overcome, to a certain extent, for more than fifteen years past, excepting the last—the evolution of hydrogen. The price at which they have been overcome, however, is almost suicidal to success. The action of heat upon the solution is not only to increase its solvent power, and its electrical conductivity, but also to somewhat increase the expense and trouble of working the process. An increase in the number of cells of which the battery is composed, or of the electro-motive force, acts in a similar manner to heat in regard to the solvent power and electrical conductivity of the solution this, however, not only largely increases the expense, but tends to overcharge the solution and to produce a brittle deposit that is also spongy, the sponginess or initiative tree-like formation arising from the evolution of hydrogen gas during deposition. Nevertheless, by the combination of these two agents, heat and increased electro-motive power, the solution of cupric cyanide in potassic cyanide is enabled to deposit copper upon iron in a form which is barely marketable, but which is obliged to be varnished, and then has scarcely the metallic appearance of a good application of bronze powder.

The evolution of hydrogen gas during deposition is not a difficulty that the early workers in electro-metallurgy would have anticipated, for (with the exception of the cyanide silver solutions) it did not occur to them to employ other salts than those of the metal to be deposited. When, however, the salts of the alkaline metals are employed, instead of the simple acids or hydric salts, as solvents for the metals to be eliminated from a given solution by means of electrolysis, the disposition of the metal of the alkali to go to the negative pole along with the metal dissolved in it, renders the alkaline solutions prone to evolve hydrogen from the decomposed water of the solution.

The prevention of the evolution of hydrogen gas from the cathode lessens the amount of electro-motive force required and tends to the formation of a solid deposit, and one that does not consist merely of a very fine network but is continuous over the whole surface covered, it also tends to preserve the solution in the normal condition and to improve the quality of the metal. A remark from Dr. Miller, of King's College, to the writer, led to the discovery of a method of working without the evolution of hydrogen, and Dr. Frankland, of the Royal College of Chemistry, suggested to him (the writer) a means of carrying out that method which ultimately proved to be practical. This method, consists in supplying to the ordinary cyanide solution, or to a solution set forth in the Patent Specification No. 1540 (A.D. 1857), after the cyanide of copper is dissolved therein to the proper extent, the hydrated oxide of copper in a wet state, in small but sufficient quantity; as a means of adjustment and absolute prevention, the blue or purple ammoniuret of copper may be added.

When the cyanide of a fixed alkali and a salt of ammonia are mixed to form an electrolytic solvent solution, the resulting solution, with some exceptions, is found to have the remarkable property of dissolving a brass anode and of giving up the brass to a cathode (of cast- or wrought-iron for instance), in a tolerable reguline form, but with the copious evolution of hydrogen gas, the proportions of copper and zinc in the resulting alloy being dependent upon the heat of the solution and also influenced to some extent by the electro-motive force and by the relative size (area) of the anode and cathode.

Having tried many of these cyanogen compounds, the writer has found a mixture of potassic cyanide and ammonic tartrate to give the best results and the least evolution of hydrogen; the addition of the wet hydrated oxides of the metals however, and especially of the ammoniuret of copper, entirely removes the tendency to the evolution of hydrogen. This combination of the solvent solution is treated of in Patent Specification No. 1540 (A.D. 1857), and the method of preventing the evolution of hydrogen in No. 3930 (A.D. 1868).

The action of the ammoniuret of copper in stopping the evolution of hydrogen, appears to be that of carrying oxygen to the cathode and thus enabling the hydrogen that would otherwise be evolved to unite with a sufficient proportion of oxygen to form water and to continue in solution. Upon this supposition, which is merely put forward as a suggestion, the ammoniuret of copper, as a whole, acts as a cation which, when it arrives at the cathode, is itself decomposed into metal, ammonium, and oxygen. According to this idea, the action which takes place may be stated by the formula

$$Cu(NH_4)_2O_2 + H_2 = Cu + 2(NH_3) + 2(H_2O).$$

The best containing vessel for the copper or brass solution is a wrought-iron tank with a steam jacket and suitable fittings to it.

Articles of wrought-iron or steel are comparatively easy to electro-coat, care being taken to select good material, well puddled and free from scales or scoriæ. The metal is taken from the workman's hands, if greasy, it is immersed for a few minutes in a boiling solution of caustic potash—one part of potash to ten parts of water—it is preferable, however, to keep grease away from articles that are to be electro-coated. It is then washed in running water and pickled in a bath containing one part by measure of oil of vitriol to twenty parts of water; this operation should not continue longer than is necessary to thoroughly free the iron from scale and to expose the absolute metallic surface. The heat at which the electro-depositing bath is used serves to finally cleanse the surface of the article (which should be washed before immersion therein), and promotes the adhesion of the deposit, it is well, therefore, to allow the articles that make up a charge for a bath to remain in a short time before completing the electrical circuit. At first the electric power should be small and it may be increased as the coating proceeds. The completed articles may be washed and well rubbed with hot mahogany sawdust. being allowed to remain therein for some hours.

Cast-iron is, perhaps, the most difficult substratum on which to build up an electro-deposit, but with care and by the selection of good material, the above-mentioned solutions furnish good results. The casting, trimmed, direct from the foundry, is pickled as above, washed, and well scrubbed with sand and water until its true metallic lustre appears in all its parts, it is then coated with copper in the alkaline copper bath, and when well covered, is removed to the electro-brassing bath, unless it is desired to copper it only. The operations require greater attention than those for wrought-iron and the final washing and drying should be thoroughly performed.

By this process, one Smee's cell may be used; six were originally requiring for electro-brassing. The cost has been found to be about 2s. 6d. per lb. of metal deposited. One ounce and a half of copper or brass per square foot will protect iron from rust.

A separate bath should be used for wrought and cast-iron, and even for different qualities of cast-iron. Order, cleanliness, and well-trained manipulation, in this department of applied chemistry, ensure success.

74, Brecknock Road, London, N.,
June, 1870.

ON CYCLOPIC ACID,

A NEW FLUORESCENT SUBSTANCE EXTRACTED FROM THE CYCLOPIA VOGELII.*

By ARTHUR H. CHURCH, M.A. Oxon, F.C.S.

ONE of the plants used by the African Boers, for tea, is the *Cyclopia Vogelii*. Endeavouring to extract theine from the dried leaves and flowers of this plant, I met with a substance apparently new to science, and possessing one remarkable property, that of a high degree of fluorescence. This character is best seen when a crystal or two of the new body is dropped into a solution of caustic soda and viewed in sunlight. An intense greenish yellow fluorescence is perceived at first, but disappears in the course of some hours.

I have named the new substance *cyclopic acid*. It is extracted by enclosing a pound or so of the dried leaves in a cloth, and immersing this for some days in water at about 30°—40° C., occasionally squeezing the cloth. A yellow powder gradually accumulates at the bottom of the vessel of water, and should e dissolved in a mixture of ether, alcohol, and water, acidified with a drop of acetic acid. By two or three re-crystallisations from weak alcohol, the cyclopic acid is obtained pure. It contains only carbon, hydrogen, and oxygen; different samples gave closely accordant results on analysis—

	Percentages of Carbon.	Percentages of Hydrogen.
1.	53·43	5·78
2.	53·58	5·92
3.	53·40	5·13
4.	53·36	5·62

These numbers correspond pretty fairly with the formula $C_7H_8O_4$, which demands the following percentages:—

Carbon	53·84
Hydrogen	5·13
Oxygen	41·03
	100·00

The formula, $C_7H_8O_4$, is rendered more probable by the result of neutralising cyclopic acid with a standard solution of ammonia. The formula indicated for the ammonium cyclopate thus produced was $C_7H_6[NH_4]_2O_4$.

It is possible, however, that cyclopic acid contains more hydrogen than assumed above, in which case it would have the formula $C_{14}H_{18}O_8$, and its ammonium-salt be $C_{14}H_{14}(NH_4)_4O_8$.

* Communicated by the Author. From the Report of the Chemical Department, Royal Agricultural College, Cirencester.

ON THE ESTIMATION OF FERROUS OXIDE, IN PRESENCE OF FERRIC OXIDE, IN SILICEOUS MINERALS.*

By CHARLES A. WILBUR and WALTER WHITTLESEY,
Students in the Massachusetts Institute of Technology.

AT the suggestion of Prof. Storer, we have applied the observation of Avery† to the estimation of ferrous and ferric oxides in silicates. Avery found that silica and many silicates can be readily and completely dissolved by a mixture of some normal fluoride with almost any of the stronger acids, whether concentrated or dilute. He has promised to work out a method of determining all the constituents of a silicate in a single portion of the mineral after having dissolved it in a mixture of fluoride of barium, fluoride of lead, or the like, and nitric or chlorhydric acid.

We have confined ourselves to the estimation of the two oxides of iron, and have obtained satifactory results so easily that we are led to hope and believe that our process will be found worthy of being generally adopted for the estimation of iron in silicates. Our method is as follows:—

A quantity of the finely-powdered silicate to be examined is weighed in a platinum crucible; as much, or rather more than as much, powdered fluor spar, free from iron (or of powdered cryolite), is poured into the crucible; the powders are thoroughly mixed by stirring with a glass rod; the rod is wiped clean upon a fresh portion of the powdered fluoride; and the latter is thrown upon the mixture in the crucible. Strong chlorhydric acid is then poured into the crucible, until the powder is thoroughly drenched and the crucible about two-thirds filled with the liquid. The crucible is set upon a water-bath, and heated until the iron has all dissolved; and the proportion of iron is finally determined by titrating with a standard solution of permanganate of potassium in the usual way. To protect the mineral from the air during the process of solution, the crucible must be kept full of some non-oxidising gas, which can be either carbonic acid or coal gas, as may happen to suit the convenience of the operator.

* Communicated through the kindness of Professor Storer.
† CHEMICAL NEWS, vol. xix., p. 270.

If carbonic acid be used, it is sufficient to cover the crucible with a bit of sheet-lead, perforated with two holes, through one of which is thrust a glass tube communicating with a gas-bottle in which the carbonic acid is generated, while the other serves as an outlet for the escape of carbonic acid and acid vapours. The crucible is, in this case, simply set upon an ordinary water-bath.

When coal-gas is used (and this agent is to be preferred on the whole), the apparatus may be arranged as follows:—Set the charged platinum crucible upon a glass or leaden tripod inside a wide beaker in the bottom of which there is about an inch of water. Invert a narrower beaker within the first, so that its mouth shall be sealed by the water and the crucible be enclosed in a transparent chamber. Coal-gas is led into this chamber through a bent glass tube, which passes down between the side of the upright and that of the inverted beaker, and delivers the gas near the top of the chamber. The surplus gas escapes through another tube, similarly bent, which starts from a point below the crucible, and is burned in the outer air.

To facilitate the passage of the glass tubes, the mouth of the inverted beaker may be made to rest upon three or four bits of stone or metal, or an orifice large enough to admit the tubes may be made upon the rim of the beaker.

During the process of solution, the upright beaker is kept immersed in water, at or near the temperature of boiling. In case the coal-gas should contain any sulphuretted hydrogen, it would be well to purify it by means of a potash-tube.

We have made numerous experiments to test the accuracy of the process and determine the time needful to effect the decomposition of an ordinary silicate. After we had found, by experiments, that simple mixtures of fluor spar and acid, which had been heated for an hour or two on the water-bath, exerted no decolourising action upon the permanganate, we proceeded to compare such mixtures with those which, besides the fluor spar and acid, contained weighed quantities of fine iron wire.

The results of this series of experiments are as follows:—

WHITTLESEY.

		Weight of iron wire taken.	C.c. of chameleon used.	C.c. of chameleon calculated on 0·2 grm. of iron.
1.	Iron wire with fluor spar ..	0·1330	19·30	29·02
	,, without fluor spar	0·1290	18·80	29·22
2.	,, with fluor spar ..	0·1010	14·70	29·20
	,, without fluor spar	0·1010	14·70	29·20
3.	Iron wire with fluor spar which had been ignited..	0·1268	18·40	29·02
	Iron wire without fluor spar	0·1268	18·25	28·78

WILBUR.

	Weight of iron wire taken.	C.c. of chameleon used.	C.c. of chameleon calculated on 0·2 grm. of iron.
Iron wire with fluor spar ..	0·2450	36·37	29·67
,, ,, ,, ..	0·1680	24·45	29·11
,, ,, ,, ..	0·1680	24·50	29·29
,, ,, ,, ..	0·1940	28·60	29·48
,, ,, ,, ..	0·1940	28·75	29·63
,, ,, ,, ..	0·1630	24·35	29·87
,, ,, ,, ..	0·1870	27·35	29·78
,, ,, cryolite.. ..	0·1740	26·50	30·46
,, ,, ,, ...	0·1620	24·62	30·40
,, ,, ,, ...	0·1632	24·87	30·48
* ,, ,, fluor spar ..	0·1810	26·87	29·69
*Sulphate of iron and ammonia	1·1989	25·40	29·66
*Iron wire with fluor spar ..	0·2290	34·00	29·69

* Final experiments made to test accuracy of process.

We next proceeded to estimate the amount of protoxide of iron in a couple of specimens of trap-rock, A from the slate-quarry on Milk Street, near the Bleachery, and near Laurel Street, in Somerville, Mass.; and B, trap from west side of the slate-quarry near the Powder-House in Somerville; dip nearly vertical; strike about N. and S.

TRAP A.

Amount of trap taken.	C.c. of chameleon used.	Per cent of FeO found.	
0·9020	11·2	11·39	Whittlesey.
0·9300	11·8	11·64	
0·8730	11·2	11·77	
0·9120	11·0	11·03	
0·3640	5·0	11·82	Wilbur.
0·2867	4·0	11·95	
0·5230	7·0	11·53	
0·3957	5·0	10·87	
0·5512	6·0	9·37	
0·3730	4·5	10·39	

TRAP B.

Amount of trap taken.	C.c. of chameleon used.	Per cent of FeO found.	
0·4850	4·6	8·21	Wilbur.
0·6500	5·4	7·17	
0·2848	2·5	7·68	

The times of exposure to heat, upon the water-bath, of the mixtures of trap, acid, and fluor spar differed widely in the different cases.

We find that an hour and a half is ample for the solution of the iron in 0·5—1 grm. of the finely-powdered trap. Fifteen minutes, on the other hand, will suffice for the solution of 0·2 grm. of iron wire.

Instead of chlorhydric acid, sulphuric acid may be used to act upon the mixture of fluor spar and trap, as was done in the third and fourth experiments of the foregoing list, trap A. The sulphate of calcium formed in this case is objectionable, from its liability to envelope portions of the mineral and to protect the iron from being dissolved, rather than from any tendency to interfere with the actual titration.

Experiments were next made to determine whether the presence of sesquioxide of iron could interfere in any way with the estimation of the protoxide.

Commercial iron-alum, which of itself had no decolourising action on chameleon, had none after it had been heated with cryolite and chlorhydric acid. It was found, also, by acting upon weighed quantities of iron wire mixed with cryolite and iron-alum, that the iron can be estimated as well in the presence of the alum as in its absence, provided only that the metallic iron be dissolved in chlorhydric acid, with the necessary precautions to prevent oxidation, before adding the other ingredients of the mixture. If the iron wire, cryolite, and ferric alum were treated all at once with acid, some of the hydrogen generated by the solution of the metallic iron would reduce a part of the ferric salt; so that, in the final titration, more iron would be found than was introduced into the mixture in the form of wire.

To determine whether ferric oxide which had been strongly ignited could be dissolved by the process in question, one of us heated a couple of samples of the ignited oxide with fluor spar and chlorhydric acid during three or four hours, upon a water-bath. The dissolved iron was then reduced with zinc, and titrated with chameleon.

In the first experiment, the ferric oxide was in the form of small lumps; in the second it was powdered.

Weight of Fe_2O_3 taken.	C.c. of chameleon used.	Per cent of Fe found.	Theory requires per cent.
0·1175	6·37	36·35	70·00
0·1172	12·10	69·17	70·00

It would appear that, if time enough be allowed, finely-powdered ferric oxide can be dissolved in this way, even after intense ignition.

To estimate ferric oxide in a silicate, a separate portion of the mineral may be treated with fluor spar and acid, the solution reduced by zinc in a small flask in the usual way, and the total amount of iron determined with chameleon. Or, if the mineral contains only a small proportion of ferric oxide, it will be sufficient to put a bit of zinc into the crucible with the mixture of mineral, fluor spar, and acid. The difference between the total iron and that determined as ferrous oxide is calculated as ferric oxide.

Two samples of trap A dissolved as above, with the addition of metallic zinc to the crucible, gave:—

	I.	II.
Weight of trap taken ..	0·285	0·4052
C.c. chameleon used ..	5·000	7·0000
Per cent of FeO* found ..	15·110	14·8800

We also fused two samples of the same trap with carbonate of sodium, dissolved in chlorhydric acid and water, and reduced with zinc in a flask.

	I.	II.
Weight of trap taken ..	0·4783	0·6849
C.c. chameleon used ..	8·3700	12·2500
Per cent of FeO* found	14·7500	15·0600

Two samples of impure iron-alum, dissolved in chlorhydric acid, and afterwards reduced with zinc in a flask, gave:—

	I.	II.
Weight of alum taken ..	1·2462	1·486
C.c. chameleon used ..	17·2500	20·120
Per cent of Fe_2O_3 found..	12·9500	12·670

Two samples of same alum, treated in crucible with cryolite and acid in the same manner as the trap, and afterwards reduced in a flask with zinc, gave:—

	I.	II.
Weight of alum taken ..	0·8505	0·8465
C.c. chameleon used ..	12·0000	11·6000
Per cent of Fe_2O_3 found	13·1900	12·8500

Boston, April, 1870.

ON SOME CIRCUMSTANCES WHICH FAVOUR THE

SIMULTANEOUS PRECIPITATION OF ALUMINA AND MAGNESIA BY AMMONIA.

By LAURENCE F. J. WRINKLE,
Student in the Massachusetts Institute of Technology.

It was observed, long ago, by Abich (*Poggendorff's Annalen*, 1831, xxiii., 352), that the alumina precipitated by ammonia from mixed solutions of aluminum and magnesium salts, may hold considerable quantities of magnesia in insoluble combination; and that the whole of the alumina cannot be dissolved from such precipitates by boiling with caustic lye. The observation has been repeatedly verified, in the laboratory of the institute, by students who have endeavoured to analyse a mixture of Epsom salt and potash alum by the second of the methods laid down by Galloway, on page 86 of his "Manual of Qualitative Analysis," (London, 1864). It is there directed to dissolve, in the smallest possible quantity of boiling dilute chlorhydric acid, the precipitate produced by ammonia in the boiled filtrate from the precipitate produced by sulphuretted hydrogen, in the ordinary course of analysis, and to add to this acid solution, when cold, a cold solution of soda or potash. The purpose of the alkali is to bring the aluminum and chromium, if any there be, into solution, while iron is left behind. But in the case of the mixture above-mentioned, the alumina fails to dissolve in the alkali. An insoluble compound of aluminum and magnesium is left, to be mistaken, perhaps, for iron.

I have, myself, repeated the experiment by adding ammonia to the solution of a mixture of alum, Epsom salt, and chloride of ammonium, and then boiling the precipitate with caustic soda for a couple of hours, after it had been collected and washed. On washing and testing the large portion of the precipitate which remained undissolved by the soda, I found that it contained an abundance of alumina.

Abich supposed the precipitate to be a mere compound of alumina and magnesia, like the mineral spinel, and proceeded to support this view by the following experiment:—Having weighed out quantities of alum and Epsom salt in such proportions that the oxygen ratio of the alumina to the magnesia was as three to one, he dissolved each of the salts in water, and treated the solution of sulphate of magnesium with so much chloride of ammonium, that the liquid no longer became cloudy on the addition of ammonia. He then added this magnesium mixture to the alum solution, saturated the whole with ammonia, collected the precipitate upon a filter, and tested the filtrate for magnesium. Since scarcely a trace of that element could be found in the filtrate, he, naturally enough, concluded that the magnesia had been precipitated by virtue of its affinity for alumina.

Abich's conclusion that a more or less definite aluminate of magnesium may be formed by precipitation, even in presence of chloride of ammonium, would seem to be supported, moreover, by his own analogous experiments on the precipitation of magnetic oxide of iron, in the wet way (*loc. cit.*, p. 353), and by the recent observations of Nichols (*American Journal of Science*, 1869, vol. xlvii., p. 16), "On the Precipitation of Insoluble Chromites of Magnesium by the Addition of Ammonia to Mixed Solutions of Salts of Magnesium and Chromium."

On examining into the matter, however, by direct experiment, it does not appear that the foregoing conclusion is justifiable. On the contrary, I find, in comformity with the statement of Fresenius ("Quantitative Analysis," London, 1865, p. 369), that it is possible so to precipitate the alumina by ammonia from a mixed solution of aluminum and magnesium, highly charged with chloride of ammonium, that no magnesium, or only an insignificant trace of it, will be dragged down.

It is noteworthy that the manner in which the ammonia is added to the solution has an important influence on the composition of the precipitate. I find, moreover, that far more magnesia will be dragged down by the alumina in case the solution contains a sulphate than if no sulphuric acid be present.

If the mixed solution of alumina and magnesia, charged with chloride of ammonium, be completely free from sulphuric acid, and if the ammonia water is added drop by drop to the hot solution (with constant stirring) until it is slightly in excess, the hydrate of aluminum thrown down will be entirely free from magnesium, or, at the most, will retain only a slight trace of that element. But if, on the other hand, an excess of ammonia be poured into the mixed solution rather quickly, a considerable quantity of the magnesia will go down with the alumina, even when no sulphuric acid is present.

If the solution contain the aluminum and magnesium in the form of sulphates, I find that as much as two equivalents of magnesia may be carried down by each equivalent of alumina, in case the ammonia is poured quickly into the solution. Probably a considerable larger proportion of magnesia could be thus dragged down by alumina from liquids more highly charged with the magnesium salt than mine were. But if the ammonia be added slowly, drop by drop, to the mixed sulphates of aluminum and magnesium, no more than 1 or 2 per cent of magnesia will be found in the dried precipitate.

I believe that if sulphuric acid be excluded, and the directions given by Fresenius for precipitating alumina by ammonia (*loc. cit.*, pp. 169, 369), be strictly followed, the precipitate may always be obtained practically free from magnesia.

A solution free, or nearly free, from sulphuric acid, was prepared for use in the foregoing experiments by precipi-

* Calculating all the iron as ferrous oxide.

tating a dilute (but as I would believe, not sufficiently dilute) solution of ammonia-alum (containing 1·3 grms. of Al_2O_3 to 750 c.c. of water) with ammonia, dissolving the washed precipitate in chlorhydric acid, and again precipitating, washing, and dissolving in the acid. The final solution of chloride of aluminum still contained a trace of sulphuric acid, but was thought to be pure enough for use.

To test the influence of the rapid addition of ammonia upon the amount of magnesia precipitated from solutions free from sulphuric acid, several quantitative determinations were made, with the following results:—To 50 c.c. of the above-mentioned solution of alumina in chlorhydric acid, containing 0·2575 grm. Al_2O_3, there was added 0·1 grm. of pure, dry magnesia, so that the proportion of MgO to Al_2O_3 should be as 1 : 1, and about 5 grms. of chloride of ammonium. The solution was diluted to the volume of about 700 c.c., heated to boiling, and a considerable excess of ammonia water was quickly poured into it. The filtrate from the well-washed precipitate was evaporated to a small bulk, aud the magnesia contained in it was precipitated by diphosphate of sodium. In the filtrate there was found 0·0854 grm. of MgO. Hence it appeared that 0·1 ... 0·0854 = 0·0146 grm. of MgO had been carried down by the alumina. In two other experiments, performed in the same way 0·0798 grm. and 0·0964 grm. MgO were found in the filtrates. Magnesia was detected also in each of the three alumina precipitates.

The following experiments, on the other hand, were made with mixtures of Epsom salt and ammonia-alum. The solutions were made in each case by dissolving 1·23 grms. of Epsom salt and 2·2675 grms. of ammonia-alum, respectively, so that the proportions of alumina and magnesia in each mixture should correspond to the formula $2MgO,Al_2O_3$.

I. Four solutions were made by dissolving the above quantities of alum and Epsom salt, together with 10 grms. of chloride of ammonium, in 750 c.c. of water; the solutions were heated to boiling, and to two of them ammonia-water was added, drop by drop, to slight excess, with constant stirring; while to the other two a considerable excess of ammonia was added, all at once, before the mixture was stirred. All four mixtures were filtered as soon as possible after the addition of the ammonia. After ignition, the first pair of precipitates weighed, respectively, 0·2581 grm. and 0·2641 grm.; the other pair weighed 0·4965 grm. and 0·491 grm. On adding disulphate of sodium to the filtrates from the first pair of precipitates, copious precipitates were produced immediately; but with the filtrates from the second pair it was only after standing over night that slight crystalline precipitates of phosphate of magnesium and ammonia could be detected upon the sides of the beakers. It should be remarked that the experiments in this paragraph were made subsequently to those in paragraphs II. and III.

II. A number of solutions made by dissolving alum and Epsom salt (taken in the above mentioned proportions) in about 400 c.c. of water, were mixed with large quantities of chloride of ammonium, and then heated to boiling and precipitated by the addition of a considerable excess of ammonia, added without special care or forethought. After ignition in a platinum crucible over a plain Bunsen burner, the precipitates weighed, respectively, 0·36 grm.; 0·5232 grm.; 0·5499 grm.; and 0·521 grm.; while the sum of the weights of Al_2O_3 and MgO in the solutions taken amounted to only 0·4575 grm. Whence it appeared that some sulphuric acid is apt to go down with the alumina and magnesia. Abich himself (*loc. cit.*, p. 319), noticed a somewhat similar precipitation of sulphuric acid in conjunction with alumina and magnesia, and it is well known, for that matter, that some sulphuric acid is readily retained by alumina. H. Bley (*Journal für Praktische Chemie*, 1846, vol. xxxix., pp. 1—23), has, in fact, shown by quantitative experiments, that large amounts of sulphuric acid may be dragged down by the alumina precipitated from solutions of alum.

It is to be observed, for the rest, that Abich, in his experiment of precipitating alumina and magnesia in equivalent proportions, operated with solutions of the sulphates of these substances. As now appears, it is hardly possible that he could have arrived at his erroneous conclusion if the solutions upon which he experimented had been free from sulphuric acid.

III. Seeking to avoid, if possible, this carrying down of sulphuric acid, I made other experiments, in which 10 grms. of chloride of ammonium and 750 c.c. of water were used in conjunction with the alum and Epsom-salt. The first precipitate obtained from such mixtures weighed 0·4567 grm., and the next 0·4754 grm., after long-continued heating over a plain Bunsen burner. In order to gain some idea of the proportion of sulphuric acid in this second precipitate, it was repeatedly heated over a gas blast-lamp for periods of ten or fifteen minutes, with the following results:—Weight of precipitate after plain Bunsen burner, 0·4754; after first blast, 0·4434; after second blast, 0·4334; third, 0·4317; fourth, 0·4314.

On a third trial, where the ammonia happened to be added strongly, the precipitate weighed only 0·255 grm. Since the pure alumina in the mixed solution amounted to 0·2575 grm., I was led by this remarkable result to make the experiments which have been recorded above, in paragraph I.

It is noteworthy that the appearance of the precipitates produced by the quick addition of ammonia is dissimilar according as they are obtained from solutions free from, or charged with, sulphates. The precipitates thrown down in this way from solutions of alum and Epsom-salt are dense and very difficult to filter; while those obtained from solutions of chlorides resemble ordinary precipitated hydrate of aluminum.

Before I had satisfied myself that it is easy to precipitate alumina almost free from magnesia by the method above described, I made several attempts to estimate the proportion of aluminum and magnesium in these insoluble basic sulphates, without, however, obtaining any very satisfactory results. The method of analysis employed was that of Deville (*Journal für Praktische Chemie*, vol. lx., 9), based upon the decomposability of nitrate of aluminum at a moderate heat. This process seems to yield good results when properly applied; but I experienced some trouble with it at first, from attempting to operate upon the mixed precipitate after it had been ignited. The ignited precipitate is scarcely at all soluble in hot concentrated nitric acid, even when the acid is made to act upon it for a long time; and it is not altogether easy to obtain a good separation of the magnesia and alumina after the precipitate has been made soluble by fusion wtih an alkali. The ignited precipitate can, of course, be dissolved in nitric acid after fusion with caustic or carbonated alkali; but, for my own part, I prefer not to ignite. The best way is to dissolve the moist precipitate immediately in nitric acid, to determine the alumina and magnesia in it, after Deville's directions, and to estimate the magnesia in the original filtrate for the sake of control.

I tried to decompose the ignited precipitate by fusion with nitrate of potassium, but abandoned the process on account of the risk of some material being carried off by the gases which are evolved as the nitrate decomposes.

When a very small quantity of the ignited precipitate was heated intensely with carbonate of calcium, over a blast-lamp, it became easily soluble in nitric acid; but, when as much as 0·3 to 0·4 grm. of the precipitate was operated upon, I could not obtain complete solution in this way. In using Deville's method, care should be taken to obtain nitrate of ammonium which is entirely free from non-volatile substances.

In attempting to analyse the mixed precipitate of alumina and magnesia obtained from Epsom-salt and alum, I was continually annoyed by the circumstance

that small quantities of alumina were dissolved, together with the nitrate of magnesium, by the solution of nitrate of ammonium. But I now suppose that this soluble alumina was derived from some of the basic sulphate in the precipitate, which had escaped decomposition when the precipitate was ignited.

Boston, April, 1870.

THE FIRE ALARM TELEGRAPH OF NEW YORK CITY.*

The Fire Alarm Telegraph is designed, first, to enable any person to send a quick reliable telegraph message to the Central Station, indicating the existence of a fire near the spot from which the message is sent; and secondly, to enable the receiver of such a message to report instantly to as many other stations (the most important of which, of course, is the engine houses) as may be deemed advisable.

It is essential to the useful working of such a system that it should be always ready to respond instantly to the demands upon it; that the message sent should be positively reliable; that the condition of the out-door structure should at all times be under complete inspection of the Central Office; that an ordinary injury to the out-door structures may be instantly known and quickly repaired; that this injury, if not extensive may be of no serious detriment, and that a printed record of the transactions of the day, and the fidelity of those in charge, shall be produced. Such are the requirements of a perfect fire telegraph. How they are met will require an explanation in full detail of the construction, the machinery, and their varied combinations.

Lines.

These are so built that only a few stations are embraced in each, and they are so interwoven that contiguous stations are upon different lines, so that an injury to one line, which might put one station out of order, would have no effect upon the next nearest station—because that one would be placed in connection with a distinct and separate line. The wires are very strong, and of unusually high conductivity, so that the currents of electricity may flow through without impediment. The various lines extending from the Battery to Spuyten Duyvil all finally converge at the Central Office; one end of each of the 56 coming in from the North and the other end of each from the South. They leave the tall poles in front of the head-quarters, and are conducted carefully over its roof and down to heavy spars, whence they pass directly into the office. Here they are continued systematically to the batteries and instruments, but are so coloured as to designate the particular office which each has to serve.

Instruments.

The instruments and appliances at the Central Office consist of batteries, switch-board, register or receiver, indicator, transmitters, clock, repeater, and testing apparatus. The apparatus outside of the Central Office consist of automatic street signal boxes and mechanical gong strikers. All of these instruments are of the most perfect and elaborate construction, and most of them especially invented, designed, and made for the service of the complete system.

Batteries.

These are compactly arranged in series of shelves, so as to be easily accessible. The shelves and stands are very thoroughly insulated, and the peculiar form of the battery keeps it perfectly clean and dry. The zinc element of this battery is so formed as to make a cover to the glass jar, and thus prevent evaporation and the introduction of foreign matter in the interior. All batteries give off currents of electricity of various power, according to the amount of chemical substances destroyed—but they are almost universally constructed so that the plates are plunged into a reservoir of acids or chemicals, which act directly upon the plates, unless labour is expended upon them to keep them protected, or upon the other parts of the battery to keep them clean. There is thus a large amount of destruction of material independent of that due to the evolution of electric force. This destruction is called local action. If this abnormal action can be guarded against, two beneficial results ensue—economy of material is secured and constancy of electric force and incidental labour is saved. The constancy of force is a very great consideration in a system where, for the first time, is introduced apparatus for the exact and instant measurement of electric force on every line. The experiments to secure this evenness of power and small consumption of material were carried on for more than a year upon the old lines of the New York fire telegraph. For more than twelve months a steady current was supplied by means of these batteries—the only labour required being the occasional supply of crystals. Without describing any other features of the battery, it may be simply said that the principle of the long endurance is found in the arrangement by which a steady but minute supply of active chemical is supplied continually; the supply is regulated to the requirements of the line. Only one-tenth of the expenditure of chemicals and labour are required. As it has been considered the best policy to keep the entire system of lines in a state of continuous and simple intercommunication, and as the expense of sustaining such batteries has been so much reduced, a very large number of cups are maintained, which, if extended, would occupy nine hundred feet in length. Beside these batteries others are provided for special purposes. The wires leading from these batteries are carried into the operating room symmetrically, and with a view to their easy and instant identification.

The Switch Board.

In all cases where many wires carry electrical currents into offices it becomes necessary at times to change the direction of these currents—to transfer them from one wire to another for various purposes—just as an engine and train of cars are diverted from one track to another. The same name is given to these devices, viz., "switch." When many wires are introduced, each requiring its switches for its various purposes, the assemblage is called a "switch-board." That of the New York fire alarm is superbly mounted, is nine feet in length, and has upon it upwards of five hundred switches, each performing its own special duty—but also arranged and grouped together so that very many may be moved by one common impulse, as when it is required to convert certain series on the entire number of lines from receiving to transmitting lines. To prevent oxidation the rubbing surfaces are heavily coated with platina. This combination gives the operator in charge the power of instantly applying to each and every line the changes which will be described. Unlike ordinary telegraph lines, the wires of the fire alarm do not pursue their course from the Central Office to the most distant station, and then dipping into the earth, consign the electric current to it, to be carried through it to the point of starting—thus making the earth the conductor for the return current—but the currents of the fire alarm return by wires. They leave and return to the office in what are called "metallic circuits." It is far better where lines are comparatively short to make the entire conductor metallic. If no connection is had with the earth in any part of the line, slight defects of insulation and contact with houses or poles do not seriously affect the working of the circuits. Exigencies occur when it becomes desirable to divide the lines for tests or repairs. Through the switch-board the operator turns his north end into the earth, with or without a battery; also the south end, with or without a battery; or, in case of the apparent

* Communicated by Professor Morton.

weakening of the battery, as made evident by a little tell-tale instrument yet to be described, he has the power of testing the exact force of his battery either off or on the line. He can also instantly exchange his enfeebled battery for his choice of several fresh ones, and he may change the course of the current of either of these fresh batteries, or, finally, he may place any one or all the lines in communication with the "repeater," thus changing them from receiving lines to transmitting.

Usually it is desirable to send out alarms, not only to all the alarm stations—that is, the engine houses, &c.—but also back again to the signal boxes throughout the whole island. The change, therefore, of all the lines from "signal" (that is, those that give the first alarm *to* the Central Office) to "alarm" (that is, those that receive the alarm sent out *from* that office) can be effected by almost a single movement on the switch-board. In order to give simplicity and order to the arrangement of this instrument, each and every line has its series of switches for these various changes arranged in rows. Every switch has designated upon it, in raised letters, the office it performs. Each and every line is alike, and each is numbered. They are also divided in sections of eight lines, so that it becomes quite easy to refer to any line without loss of time. Immediately in connection with the switch-board is a series of

Galvanometers.

These are instruments which measure the force of current on the line by deflection of a needle. A few degrees indicate a weak current, and many degrees a strong one. It is thus a valuable register of the state of the line—for the normal condition of the line being twenty degrees, ten degrees would indicate that the battery was becoming weak, and forty degrees would indicate that the battery was becoming stronger, which could not easily occur, or else that resistance at the line was lessened, or that the current had found some short road easier for it to travel than through all the length of the line with its numerous magnets. This measurement by degrees would be only a partial indication of the state of things. Hence to every one of these galvanometers is added that which makes the test an exact one. The "resistance" of a circuit or line is that obstacle it presents to the free passage of the electric current. Through a short circuit of large wire a large volume of electricity will pass and exercise powerful force upon magnetic instruments. Through a long circuit of fine wire the reverse is the case. Suppose a line five miles in length has included in it ten magnets, each of them being furnished with wire a mile long—or, as it is called, a mile "resistance"—the whole resistance would then be fifteen miles; but, if the current, instead of passing through all this length, proceed only two miles, and through only five magnets, and then gets back again, it is evident that it meets with only seven miles of resistance instead of fifteen. Hence we can often locate a trouble if we know the exact resistance of a line and compare it with the normal resistance of that line when all is in proper working order.

The process of ascertaining the exact resistance is as follows:—The needle of the galvanometer is made to deflect by the influence of a long coil of wire placed under it. When the current passes through the coil in one direction the needle deflects to the left; but we may add another coil of exactly equal power, so wound and placed that the needle may be pulled (by equal current) just as strongly to the right. Now, if we give a chance to the current from the same battery to go around these two coils at the same time, just as much will flow through each, and the needle being pulled in two ways with equal force, it will stand at zero. Again, if we add resistance to the wire connected with one coil and none to the other, then a greater part of the current will take the short road, and the coil without resistance will pull the needle the strongest. Hence, if we have a known adjustable resistance connected with the second coil, and the first coil is connected with the line, when we have so altered and increased or decreased the known resistance that it equals the line resistance, and the needle stands at zero, the line resistance, of course, equals the measured resistance exactly.

The very resistance of lines thus tested daily, and recorded in a book, will be a complete history of the state of such lines. The instrument which contains the coils of measured resistance wires, by a combination of which any desired length of resistance is thrown in is called a "rheostat." In the Central Office it is arranged unlike any other such instrument, so that the changes may be made almost instantly, and at the same time can be read off in decimal numbers, indicating miles and tenths of miles.

The Register or Receiving Instrument.

This is the apparatus by which are recorded all the alarms that are sent into the Central Office, and all the tests of the day and night. The currents from the lines do not immediately proceed to this machine, but through the usual intervention of the relay magnet, of which fifty-six, in very compact form, are arranged upon the register-table. These relays act upon the register, and also, at the same time, upon an electric annunciator, by which the number of the line is indicated. When a signal is communicated to the Central Office from a street box, the first operation the box performs is to disturb and break up the current that steadily flows through the line at all times, and holds the relay magnet steadily charged. This break discharges the little magnet, its lever falls back, and, in so doing, instantly performs four operations. First, it throws down into view the number of the line called into action; it causes a bell to be rung; it starts the register wheel-work into revolution, and it prints a dot in ink upon a broad band of paper, which is rolled through the machine. If this single action was all that took place a single dot would be printed on the paper, which would run out about three inches and then the revolution would instantly cease, but it can be arranged that the paper shall run only two inches, more or less, before it stops. As long, however, as the line continues to be active by sending off signals, just so long will the paper keep running—always stopping, however, two inches, more or less, as adjusted, after the very last impulse from the line. This paper roll is about ten inches wide. Fifty-six pens, actuated by fifty-six magnets, are arranged beneath it, so that each and every one may be brought to bear upon the paper. Each one is connected with a separate line. The pens are numbered to correspond with the lines, from one to fifty-six.

Suppose that the signal 256 is to be sent in. The street box which sends this particular signal is one of those connected with line No. 21. The operation, then, of the bringing that box into action is, first, to start the paper roll into movement, and to throw into sight No. 21, to call into action the twenty-first pen, which, with great exactness, prints the signal 256 in ink upon the paper five times, and then the paper stops itself two inches after the last printed dot. Thus every signal sent over any of the lines is printed upon this same roll of paper either day or night. But the paper also records clearly another signal, which is automatic. A very fine regulating clock is suspended on the wall of the office. Precisely at each hour on the beat of the first second a type corresponding with the hour of the day strikes upon the paper roll and prints it. In the daytime the hour figures are different from those indicating the night hours. At the same moment a small bell is started, ringing continuously, notifying the operator in charge that the hour has come, and that he must proceed to test all his lines, and print the record that he has done so upon the paper. His duty is then to open for an instant each and every key on each and every line. These keys being arranged in groups of eight, may be struck in groups or singly. The single touch of all these keys makes upon the register paper fifty-six dots corresponding with the fifty-six lines; and if no alarm of fire should come in to be recorded on the same paper, on

any one of the lines, then, at the commencement of the next hour, it would be printed in the same way as before on the paper, and another series of tests would be made. Thus, at the end of a day's operations the paper would show that, between the striking of every hour, day and night, every line had been tested and its good condition recorded upon paper: or, if its pen failed to make a record, explanation of the cause would be sought for and the difficulty obviated. Whatever fire might occur between any hours, would be also recorded in its appropriate place, and the paper thus becomes a record of the locality of every fire, the time that it occurred, and also the sound condition of all the lines. The clock which serves to actuate the printing of the hours upon the paper, can also be made easily, by the agency of certain switches, to strike the precise commencement of any hour upon each or all of the six hundred stations embraced in the entire system. In direct connection with this register, and its supplementary apparatus through the medium of the wires, are the

Street Boxes.

These boxes form, of course, a very important part of the apparatus of the system. They are fastened to the poles or engine-houses, and consist of an outer casing or house of iron, with the seal of the Metropolitan Fire Department on each, and a label covered with glass indicating to the public where the key which opens the box may be found. Every policeman is also furnished with a key, and every fireman, and the insurance patrol. When a fire occurs in the neighbourhood of a box, anyone who first obtains the key opens the outer box. Within it he perceives a second iron box, and, fastened to it, a handle to be pulled down. Printed directions are also visible, to guide in doing this simple thing in the right way, and also showing how it may be known that pulling the handle has been effective. The moment the opener of a box hears a response, he knows that his work is done. The officers in the department, who have keys for the inner box, to which the handle is fastened, discover, upon opening them, a third box, round, and tightly closed up from the air. On the outside of this third box is to be seen simply a brass arm, extending out to the right. This brass arm is fastened to the apparatus within the round box. The office of the pulling-down handle on the second box is to engage with and pull down this brass arm.

The action upon the arm winds up the machine within, which begins running down as soon as the brass arm is left free to move by the disengagement of the pulling-down handle.

Opening the round box (previously, however, removing the brass arm), within is found a very excellently finished piece of clock-work, driven by a spring, which is so attached outside of the frame that, if it breaks, another can be supplied without pulling the frame to pieces. The arm winds up the machine like a watch, but only a short distance. It begins to run down, and, in doing so, as the movement is controlled by a very perfect regulator, one of the wheels of the trains carries a "circuit-wheel," with teeth cut on it corfesponding with the particular number-signal which the iron box represents. The office of the regulated clock-work is to carry this circuit-wheel very steadily and slowly around from one to five times, as it is set. Each time it revolves, its teeth strike upon springs, and the circuit is made to open and close correspondingly. Two teeth, a space, then three teeth and another space, and then four teeth and a long space, would cause the circuit to be opened and closed so as to ring out the number 234. As every box has a circuit-wheel with a different number, the starting of the machine of any box communicates its special number with certainty, five times repeated, to the Central Office, and it is printed on the paper of the register five times. In addition to this machine, the second box contains a magnetic bell, which rings in accordance with the signal sent, and thus becomes an indicator that the message is going correctly to the Central Office; it also receives the return signal from the Central Office, and any and every desired signal which is sent out from that place. There is also a telegraph-key, by which messages, if necessary, may be sent; also a lightning-arrester; also a simple arrangement which, turned either right or left, divides the line into two parts, so that, if any accident should occur to interrupt the continuity of the circuit, preventing the current from going to or returning from the Central Office, the uninjured part of the line may be almost immediately utilised, and, instead of having ten boxes thrown out of use, the loss may be reduced to a single one. Thus a fire may burn down a pole or break a wire, but in a very few minutes the accident is known, and the line which has been broken is made into two short ones, until the time when it becomes practicable to re-unite the broken ends.

The other principal receiving-instruments in the Office consist of two extra and ordinary registers, by which the communications with the boxes which may be necessary for keeping the lines in perfect repair and good order are carried on, so as not to allow the main register to be cumbered by them. The apparatus for *sending out* the fire-signals, received from and through the machines just described, consist of the repeater, the supplementary repeater, and the mechanical gong-strikers.—*Journal of the Franklin Institute.*

ON THE

POTASSIO-COBALTIC NITRITE KNOWN AS FISCHER'S SALT, AND SOME ANALOGOUS AND RELATED COMPOUNDS.

By SAMUEL P. SADTLER.

THE composition of the double nitrate of cobalt and potash, known by the different names of "Fischer's Salt," and "Cobalt-yellow," has long been an open question. The following is a brief statement of the views advanced on the subject. Fischer,* the discoverer of the salt, made no analyses of it. St. Evre,† who re-discovered it, gave as a formula for it $K_2ON_2O_4 + CoON_2O_4$, but does not give the analytical data. Stromeyer‡ subsequently showed the incorrectness of this view, and wrote the formula $Co_2O_3,2N_2O_3 + 3(K_2ON_2O_3) + 2H_2O$. This formula is peculiar in making the atom Co_2O_3 combine with 2 atoms of N_2O_3. We shall discuss the formula and results further on. Erdmann‖ first pointed out a distinction between the salt formed in neutral solutions and the salt formed in acid solutions, which latter he considers as a normal salt. He gives both

$$2CoO,3N_2O_3+3(K_2ON_2O_3)+3N_2O,$$

and

$$Co_2O_33N_2O_3+3(K_2ON_2O_3)+3H_2O,$$

or, as we shall write it, $Co_26NO_2 + 6(KNO_2) + 3H_2O$ Braun,§ the last writer on the subject, passes most of the preceding work in review. He takes up Stromeyer's results, and rejecting his views as to the composition of the salt analysed by him, figures for it a number of ingenious but somewhat complicated formulæ. He considers that neither the "neutral salt" nor the "acid salt" of Erdman can be regarded as anything but mixtures or "poly combinations," and for the first of them considered as such, he gives a still more ingenious and complicated formula. We quote it as reduced to its empirical form by Blomstrand:¶ $Co_{62}K_{59}N_{112}H_{20}O_{454}$.** Braun's own results are expressed first by a formula containing both

* *Pogg. Ann.*, lxxii., 477, and lxxiv., 124.
† *Jr. pr. Ch.*, 54, 84, and 58, 185.
‡ *Ann. Ch. u. Ph.*, xcvi., 218.
‖ *Jr. pr. Ch.*, lxxiii., 598.
§ *Zeitsch. Anal. Ch.*, vii., 313.
¶ *Chemie der Jetztzeit*, p. 414.
** Should be O 508.

Co_2O_3 and CoO, then by one containing Co_2O_3CoO,N_2O_3 and N_2O_5 and finally by the following:—

$$3(Co_2O_3,3N_2O_3 + 4K_2O,4N_2O_3 + 2H_2O) + \\ + 2(Co_2O_3,H_2O,2N_2O_3 + K_2O,N_2O_3 + 3H_2O).$$

The experiments made to settle its composition and the results obtained are as follows:—St. Evre ignited the salt in a stream of nitrogen. Nitric oxide was given off and the residue was a black oxide, which, on contact with HCl, gave Cl, and with $C_2H_2O_4$ gave CO_2. This I cannot regard as conclusive, as mere ignition *per se* will not break up the KNO_2, so that the residue was not pure, Co_2O_3; moreover the N_2O_3 in breaking up may have given an atom of O to form the Co_2O_3. Stromeyer found that NaHO and BaH_2O_2 decompose it on gentle warming, even with exclusion of air, separating the brown hydrated Co_2O_3 which dissolves in $C_2H_4O_2$ with a brown, and in $C_2H_2O_4$ with a green colour. This observation is of undoubted value. He says, also, that on mixing the neutral solutions, the precipitate is slow in forming, and forms by an absorption of O, as is shown by dipping the connecting tube under a cylinder of air or oxygen. Erdmann confines himself to an examination of this last observation of Stromeyer's, and finds that the "neutral salt" can be formed in an atmosphere of pure CO_2, and that therefore there can be no absorption of O in the case. Braun finds that KHO acts very little upon the salt, merely changing its colour from yellow to a dirty yellowish-green. $NaHO,BaH_2O_2,CaH_2O_2$ separate, at a boiling heat, the brownish-black hydrated Co_2O_3; this is comfirmatory of Stromeyer's observation. Carbonate of silver heated with water and Fischer's salt, gave, with separation of the hydrated Co_2O_3, crystals of what, from Braun's description, were probably $AgNO_2$; KCy did not decompose it.

My own experiments directed toward the solution of the question of CoO or Co_2O_3 were as follows:—I found Erdmann's observations as to the formation of the "neutral salt" in an atmosphere of CO_2 correct. I added, by means of a funnel tube, a solution of KNO_2, boiled to expel the air, to a boiled solution of $CoCl_2$, placed at the bottom of a partially closed vessel, into which a strong stream of CO_2 had been passing for some time. The salt began, nevertheless, to form slowly. Wishing to sift the matter more thoroughly, I made a series of experiments in eudiometer tubes over mercury. Into a eudiometer tube, filled with mercury and perfectly free from air, I threw up a boiled solution of $CoCl_2$ and then one of KNO_2. The salt began to form soon at the juncture of the two liquids and then deposited steadily though slowly. After a number of hours not the slightest bubble of air was to to be seen. The absence of all chance of oxidation here, either from air or excess of nitrous acid, shows, conclusively, the protoxide nature of this "neutral salt." The "acid salt" was formed in the same manner—first a boiled solution of $CoCl_2$, then acetic acid, and then a boiled KNO_2 solution. A rapid evolution of gas ensues, and the salt forms and falls in a layer on the top of the mercurial column; in another instance a small crystal of $CoCl_2$ was sent up, and then acetic acid, and then KNO_2. The formation of the salt was almost instantaneous, and the evolution of gas exceedingly rapid. Before drawing any conclusions from this, however, the action of acetic acid on KNO_2, out of access of air, was to be studied. Gmelin* states that, when treated with acid out of access of air, nitric oxide is evolved, while the liquid takes up NO_2 and N_2O_5. This evolution was found to take place readily over the mercury, and the gas answered to the test of ferrous sulphate, and was coloured red on admission of air, like the gas evolved in the formation of the salt. The question now is whether the liberated O is taken up in the formation of the salt to oxidise the CoO, to convert the excess of nitrite into nitrate. The question cannot be definitely settled until we have some delicate test for a small quantity of nitrate in the presence of a large quantity of nitrite; but there is one thing which I regard as significant, Erdman made one of his preparations of the "acid salt" by filtering the mixture of neutral solutions into pure acetic acid. Now the greater the excess of acid, the quicker would be the conversion of nitrite into nitrate, and we should look for a very small amount of the double nitrite salt. Yet it formed as readily, and analysis proved it to possess the same constitution as the other preparations. The inference from this is, that the sesquioxide-forming power of the Co is sufficient to enable it to take liberated oxygen.

Recourse was now had to analysis as a means of determining the question. Six distinct preparations of the salt in all were made and analysed. In preparing the salt, the distinction made by Erdmann in regard to the formation of different compounds in neutral and acid solutions, was recognised, and the salt was invariably formed in a solution, strongly acidified by acetic acid in the beginning, and kept so until the end by the addition of acid, if necessary. The salt of cobalt used was the chloride, and, in all but the first two preparations, the solution was boiled to expel air, and made acid. A strong solution of KNO_2 was then added, and the mixture was left to stand; six or twelve hours generally proved sufficient, and it was then filtered and washed, according to Erdmann's direction, with a solution of potassic acetate of about 10 per cent, which was displaced by 80 per cent alcohol. The salt was then dried, first over the water-bath and then in a water-oven, exactly at 100°. I saw no evidence of a decomposition at this temperature alluded to by Erdmann.

The results of full analyses of these six preparations warrant me, I think, in presenting the following conclusions:—

1. That Fischer's salt is a *Tri-potassic-Cobaltic-Nitrite*, its essential formula being

$$Co_2O_3,3N_2O_3 + 3(K_2O,N_2O_3) + Aq,$$

or

$$Co_26NO_2 + 6(KNO_2) + Aq.$$

2. That it can be formed with $4H_2O$, $3H_2O$, $2H_2O$, H_2O, or anhydrous, according to the degree of concentration of the solutions used, passing in colour from a light yellow to a dark greenish-yellow.

3. That in consequence of such dependence, we can, in most preparations, fix no absolute point, but are liable to have a mixture of salts of different degrees of hydration.

The analytical methods used in the analyses of the salt were the following:—

The Co was determined first together with the K, as a double sulphate having the invariable constitution $Co_2K_6SO_4$. This sulphate has a distinct fusing-point, and affords an accurate means of determination. It will be discussed further on. This is then dissolved, the solution made ammoniacal, and brought to boiling, when the Co is thrown down as CoS. This is roasted, and, after treatment with aqua regia and sulphuric acid, is weighed as neutral $CoSO_4$. Or the Co was thrown down from the solution of the double sulphates as peroxide by acetate of soda and chlorine, and then reduced by hydrogen to the metallic state.

The potash is then determined by difference.

The nitrogen was determined, either together with the H_2O by Gibb's modification of Bunsen's method, which will be again alluded to, or directly by volume with the Sprengel-pump.

The H_2O either as above, or by combustion with Cu in a stream of CO_2.

Prep. No. 1.

$$Co_26NO_2 + 6(KNO_2) + 4H_2O.$$

	Theor. p. cts.	Found p. cts.
Co_2O_3	17·00	17·45
K_2O	28·94	29·00
N_2O_3	46·69	45·21
H_2O	7·37	6·99

* Cav. Soc. ed., vol ii., p. 384.

Prep. No. 2.

$Co_26NO_2+6(KNO_2)+3H_2O$.

	Theor. p. cts.	Found p. cts.
Co_2O_3	17·32	17·77
K_2O	29·48	29·70
N_2O_3	47·57	47·22
H_2O	5·63	5·43

Prep. No. 3.

$Co_26NO_2+6(KNO_2)+2H_2O$.

	Theor. p. cts.	Found p. cts.
Co_2O_3	17·65	17·96
K_2O	30·04	31·41*
N_2O_3	48·48	47·87
H_2O	3·83	4·15

Preps. No. 4 *and* 5.

$Co_26NO_2+6(KNO_2)+3H_2O$.

	Theor. p. cts.	Found p. cts.	
Co_2O_3	17·99	18·20	18·55
K_2O	30·63	30·81	30·61
N_2O_3	49·43	49·24	49·43
H_2O	1·95	3·64†	3·92†

Prep. No. 6.

$Co_26NO_2+6(KNO_2)$.

	Theor. p. cts.	Found p. cts.
Co_2O_3	18·35	18·58
K_2O	31·24	31·90
N_2O_3..	50·41	51·21
H_2O	—	0·75

It will be seen that, while the general coincidence is well sustained, there are several decided deviations. We can only call attention to certain facts in explanation. 1. We probably have in some of these preparations, mixtures of the salts of different degrees of hydration. 2. The salt cannot be purified by re-crystallisation. 3. The acetate of potash with which the salt is first washed is, as Rose‡ remarks, only removed with difficulty by the alcohol.

(To be continued).

NOTICES OF BOOKS.

First Principles of Chemical Philosophy. By JOSIAH P. COOKE, jun., Erving Professor of Chemistry and Mineralogy in Harvard College. Pp. 560. London and Cambridge: Macmillan and Co. 1870.

THE author of this work, the Professor in the celebrated American University, states, in his preface, that the object of his book is to present the philosophy of chemistry in such a form that it can be profitably made the subject of college recitations, and furnish the teacher with the means of testing the students' faithfulness and ability. The subject has been developed in a logical order, and the principles of the science are taught independently of the experimental evidence on which they rest. It is assumed that the student has already been made familiar with the evidence and with the more elementary facts which the philosophy of science attempts to interpret. The book is divided into two main divisions. Part I. contains seventeen chapters, including, besides, a clear and lucid introduction giving definitions. The chapters treat on: Fundamental Chemical Relations; Molecules; Atoms; Chemical Notation: Stochiometry; Chemical Equivalency; Chemical Types; Bases, Acids, and Salts; Chemical Nomenclature; Solution and Diffusion; Combustion; Molecular Weight; Crystalline Forms; Electrical Relations of the Atoms; Relations of the Atoms to Light; Chemical Classification. Part II. is sub-divided into two main chapters, one of which bears title "The Perissad Elements," viz., hydrogen, fluorine, chlorine, &c.; the other "The Artiad Elements," viz., oxygen, sulphur, &c. The philosophy of chemistry is developed in this book according to the "modern theories;" careful attention has been given to chemical notation, and a method has been devised of writing rational symbols which, while it fully exhibits the relations of the parts of the molecule, cendenses the formulæ, and saves space and labour in printing. The nomenclature usually current in our own Chemical Society has been adopted, but in the chapter on this subject the old names are given with the new. The metric system of weights and measures and the centigrade thermometric scale are used throughout. There are also added excellent tables of French Measures; Elementary Atoms; Specific Gravities of Gases and Vapours; and Logarithms and Anti-Logarithms, with a very correct and copious index.

As far as our recollection goes we do not think that there exists in any language a book on so difficult a subject as this, so carefully, clearly, and lucidly written. The author, moreover, deserves the thanks of all English students of chemistry and friends of science, for having entrusted the publication of his work to so well-known an English firm, and the publishers are equally praiseworthy for the excellent execution of a book, requiring, as it does for its completion, extreme care, as well as specially cut types for some of the formulæ. We recommend this work to all who desire to become thoroughly conversant with a somewhat intricate but very important subject.

Lecture Notes for Chemical Students. By EDWARD FRANKLAND, F.R.S., &c., Professor of Chemistry in the Royal School of Mines. Vol. I.—Inorganic Chemistry. Second Edition. Pp. 220. London: John Van Voorst, 1870.

THIS is the first part of a second and revised edition of Dr. Frankland's work. It is not a manual of chemistry in the ordinary sense of the word; for it says but little of the manufacture of chemical compounds: it scarcely alludes to their outward and sensible properties; but it gives many glimpses of their interior constitution. These Notes were originally published in one volume; but, at the request of numerous readers, the eminent author has divided the work into two parts, of which this volume forms the first. The author's aim has been to classify and systematise rather than to describe, and to furnish the student with a kind of skeleton of the science; it being the author's intention that the student should himself clothe and dress this skeleton with the already-known and daily-increasing facts of experimental research. To aid the student in that good and useful work, the titles of the works published by several eminent English, as well as foreign, authors of works on chemistry are quoted. The graphic notation of Dr. Crum Brown, which was adopted, in the former edition, to illustrate important constitutional formulæ, has been somewhat modified in the present, by the omission of the circles surrounding the symbols of the elements; the author's previous opinion, that these circles render the formulæ more intelligible to beginners, not having been confirmed in practice. Since, however, during the time which has elapsed since the publication of the first edition of this work, this modified form of graphic notation has been adopted by a large number of chemists, it is desirable that the student should use that form which is most extensively employed, and which, as regards constitutional formulæ, has become almost a necessity to give precision to that hypothetical reasoning which stimulates to further research.

Since this work was first published, many of its peculiar novelties have become, as might be expected, generally known and appreciated, if not as yet generally adopted

* Acetate of potash probably not all washed out by alcohol.
† Unaccountably high.
‡ *Anal. Ch. Sechste Auflage*, Zweiter Band, p. 128.

by chemists. The contents and general arrangement of this volume is not altered, but it has been increased by the addition of the constitutional formulæ of minerals. The opening chapters—Introductory, Chemical Nomenclature, Chemical Notation, Compound Radicals, Atomic and Molecular Combination—are so tersely worded that any student may readily and quickly catch the meaning intended to be conveyed to the mind. The whole book is an *epitome*, but of great utility, since the eminent author has succeeded in rendering modern chemistry, with all its at first sight great intricacies and difficulties, readily understood, whilst the disciple gradually ascends from the more simple to the more complex matters, and is almost imperceptibly brought into the domain of organic chemistry.

Eminent Men of the Day. Photographed by G. C. WALLICH, M.D. Scientific Series. London: John Van Voorst, Paternoster Row. 1870.

BIOGRAPHIES and autobiographies of those we have known, and who are honoured by us for their worth, their discoveries, and scientific attainments, are valuable, and we could ill afford to dispense with these memorials. But, after all, there is nothing more pleasant than to possess a faithful representation of the features and expression of those holding a foremost place in the ranks of science; and, in looking over these photographs, it is easy to recall the various discoveries which have led to well-deserved honours and world-wide fame.

The volume contains most characteristic likenesses of:—General Sir Edward Sabine, K.C.B; Sir Roderick Impey Murchison, Bart., K.C.B., F.R.S.; Professor Owen, D.C.L., F.R.S.; George Bentham, F.R.S.; Thomas H. Huxley, LL.D., F.R.S.; Joseph Dalton Hooker, C.B., D.C.L., LL.D., F.R.S.; Sir Charles Lyell, Bart., F.R.S.; John Tyndall, LL.D., F.R.S.; Sir William Logan, F.R.S.; Professor Stokes, M.A., D.C.L., LL.D., F.R.S.; Professor A. C. Ramsay, LL.D., F.R.S., F.G.S.; Viscount Walden; William Lassell, F.R.S.; Joseph Prestwich, F.R.S.; Rev. J. B. Reade, M.A., F.R.S.; and Professor Williamson, F.R.S.

We wish that the series could be greatly extended, so as to include many more in each department of science. We should like to see, in addition to this volume (which contains, for the most part, the presidents of the various scientific societies), a volume containing portraits of the most distinguished chemists; another, of those who have devoted years of labour to physical researches; another, of eminent geologists, &c. And we hope that this volume will have such an extensive circulation, and be so well received, that Dr. Wallich will decide upon issuing at least one more volume of scientific celebrities.

The photographs are well executed, and handsomely mounted and bound; and the book cannot fail to be highly prized.

The Fuel of the Sun. By W. MATTIEU WILLIAMS, F.C.S., &c. Pp. 222. London: Simpkin, Marshall, and Co. 1870.

UNDER this title, which, to ordinary minds, might appear absurd enough to suggest doubts as to the writer's sanity, the author has made an attempt (and a very bold one) to explain some of the greatest mysteries of the Universe.

Mr. Williams certainly deserves extraordinary credit for this work; for, although it is quite true, as he himself says, that he fairly exposes himself to the accusation of extreme presumption, the whole work bears testimony of sound and deep study of physical sciences, and of an acute mind and great sagacity for observing and applying facts. And, although the work abounds in speculations as yet not proved (and it may be doubted whether man ever will be able, while on this globe, to learn and to prove the real truth), they are here lucidly set forth in print, and are therefore suggestive of good, inasmuch as their perusal may assist others to elicit new facts.

The following quotation will give, perhaps, the key-note of the book:—

"The sun, according to my hypothesis, is a hollow flame, with dissociated combustible gases within it, and a nucleus of some kind within them. It differs from the hollow flame of a candle in the very important respect of not being dependent upon external oxygen for its support. It contains all the materials of combustion within itself; but this combustion, or combination, is restrained from proceeding explosively inwards by the dissociating force of the high temperature of the inner gases.

"When two substances, such as oxygen and hydrogen, combine chemically, they evolve an amount of heat exactly equivalent to that which is required to drive asunder the constituents of an equal quantity of the compound which they form; and, therefore, the amount of combination or combustion that can take place in a given mixture of such elementary gases is limited by the quantity of heat which surrounding bodies are capable of abstracting. To illustrate this, let us conceive the case of a certain quantity of the elements of water heated exactly to the temperature of dissociation, and confined in a vessel the sides of which are maintained externally at precisely the same temperature as the gases within, so that no heat can be added or taken away from the gases. No sensible amount of combination could now take place, as the first infinitesimal effort of combustion would set free just the amount of heat required to decompose its own result. In like manner, if a quantity of aqueous vapour were subjected to the same conditions, there would be a corresponding equilibrium; and no sensible amount of dissociation could take place, as the first effort of dissociation would be attended with a conversion of heat, and consequent loss of temperature, which would be exactly compensated by the instantaneous reunion or combustion of the infinitesimally small quantity of dissociated water.

"Let us now suppose a modification of these conditions; viz., that the vessel containing the dissociated gases at the temperature of dissociation shall be surrounded with bodies cooler than itself, *i.e.*, capable of receiving more heat from it than they radiate towards it. There would then take place just so much combustion as would set free the amount of heat required to maintain the temperature of the vessel at the dissociation-point; or, in other words, combustion would go on to the extent of setting free just as much heat as the gaseous mass was capable of radiating, or otherwise transmitting to surrounding bodies; and this amount of combustion would regularly and steadily continue until all the gases had combined.

"We have only to give this hypothetical vessel a spherical form and an internal diameter of 853,380 miles, to construct its enveloping sides of a thick shell of aqueous vapour, and then, by placing in the midst of the contained gases a central nucleus of solid or liquid matter, we are hypothetically supplied with the main conditions which I suppose to exist in the sun."

We purposely abstain from entering into further details; since, by thus dissecting, we might risk misrepresenting the contents of a work which abounds with valuable information on cosmography in its widest sense.

The work is very readable; and the typographical execution is also excellent.

CORRESPONDENCE.

ANALYSTS' FEES.

To the Editor of the Chemical News.

SIR,—Some time since, a few letters appeared in your paper on high and low analysts and their fees. Now, in the north of England, people will not pay the fees that more favoured localities obtain; but I was not prepared for a circular (which I beg to enclose) which informs the

world that a Ph.D. and F.C.S. will execute any complete analysis for £1 1s., and anything less complete for 10s. 6d. He also states that he holds testimonials from the most renowned scientific men of the day; and winds up by advertising himself as a chemical broker.

How hard, indeed, is the lot of the analyst whose views of professional *status* will not permit of dabbling in shop-keeping!—I am, &c.,

OLD PRICE.

STELLARTON ACID-WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—I have just received Nos. 548 and 549 of the CHEMICAL NEWS, and learn from them that my late paper "On the Stellarton Water," published by the Chemical Society, has been the subject of discussion. I am obliged to Dr. Gladstone for showing Mr. Spiller how my statement as to free sulphuric acid being present is quite admissible, and for explaining to him the meaning of the word *underlying* (the rocks and coal dip at an angle of 20°).

With regard to alumina being given in the deposits and not in the water, I may say that analysis was made on *filtered* water, and that insoluble aluminous matter may have been introduced into the boilers on the "fibres, apparently, of roots" mentioned as found in the incrustation. The amount present was quite trifling. I find it stated, however, in my note-book that there was a trace of alumina in both waters; and no doubt I ought to have mentioned this substance among the other ingredients (I suppose I thought it too small in amount).

As for silica mentioned in the water and not in the deposits, the amount dissolved in the water was only (at most) 0·52 of a grain to the gallon. And, being soluble, why should it necessarily have been in the deposit? and why, under the circumstances, was it material to look for it if in small amount?

Hoping that some useful discussion on essential points (especially as to arrangement of results of water analysis) may arise from Mr. Spiller's criticism of my paper, I am, &c.,

HENRY HOW.

University of King's College,
Windsor, Nova Scotia, June 16th, 1870.

MISCELLANEOUS.

The Cryophorus, &c., with Bunsen's Pump.*—Professor Cooke finds that the Bunsen Pump will serve admirably for freezing the cryophorus by evaporation of ether. The lower bulb is wrapped about with several folds of cotton, which are drenched with ether, the tube being passed through an india-rubber cork fitting into the tubulure of a receiver, which is placed upon an air-pump plate connecting with the Bunsen pump. The cold produced by the rapid evaporation of the ether in vacuo, causes the water in the upper bulb to freeze rapidly. Bunsen's pump is applicable not only in this but in many other cases in which the condensation of moisture, or the presence of corrosive gases and liquids forbid the employment of the common air-pump. As for example, the familiar experiment of making tepid water boil violently when placed in a partially exhausted atmosphere. Indeed, Bunsen's pump may be made to take the place of the air-pump for almost all purposes, and forms a most valuable adjunct not only to the laboratory, but also to the lecture-table. In the filtration of large quantities of acids, alkalies, &c., a funnel may be employed of a half-gallon capacity or larger, and closed by means of sealing-wax with a conical plug of pumice of about ¾ inch thickness. The bulb of the funnel is then passed through the tubulure of a receiver as above. Besides this useful contrivance, Professor Cooke has found the Bunsen filter to work well where large masses of precipitate must be dealt with. In this case a zinc cone, three inches in depth, which is cut, formed up and soldered in the same way as the small platinum cone, described by Bunsen, is fitted into a large funnel. Several pounds of precipitate may be thrown upon a single thickness of filter paper, which is supported by a cone of this description, and washed rapidly and completely under atmospheric pressure. If it is not desired to preserve the filtrate and wash-water, the tube of the filter may be fitted directly into the exhaust pipe of the pump, and the liquid carried off along with the air. Such arrangements as those detailed above would greatly economise the time, labour, and working space of pharmaceutists and manufacturing chemists.—*Journal of the Franklin Institute.*

* Communicated by Professor Morton.

NOTES AND QUERIES.

Bromine.—(Reply to "J. H. Watson.")—Consult the latest edition of Rose's "Analytical Chemistry," recently published in the German language; or Fresenius's "Quantitative Analysis," latest English edition.

Persulphide of Hydrogen.—(Reply to "W. B. G.")—Consult "Handbook of Chemistry," by Gmelin; Watts's "Dictionary of Chemistry;" and "Jahresbericht über die Fortschritte der Chemie," von Kopp and Will; all of which works you may inspect at the Library of the Commissioners of Patents.

Lead Roofing.—The lead on the ridgings of my house dissolves with rain, and streaks of whitish-looking stuff runs irregularly over the slates from these various ridgings. As the slates are much exposed to view, it looks very ugly in dry weather. Can any one suggest a remedy?—SLATES.

Work on Sulphur.—Can any of your numerous correspondents kindly inform me of a book on sulphur, giving a lucid explanation of its extraction from clays, pyrites, &c.; the quantity of fuel used, the percentage of sulphur which would be payable to work, and the description and average cost of plant necessary for its production as a marketable article? I have looked in Watts's "Dictionary," Muspratt, and several other works, but the information is scarcely so full as I require.—GEORGE CRAMPTON.

Latest Novelty in Orchil Paste.—The great advance in the price of orchella weeds has put the manufacturers of weed colours upon their mettle. Many sophistications have become known to consumers. So the last "improvement" is to buy up spent weed from parties who make orchil liquor for their own consumption, and incorporate it with the recent weed in the process of manufacture. Thus a very solid paste is obtained, in which the microscope reveals nothing objectionable. The only method of detecting this ingenious dodge is to compare the tinctorial power of the sample against that of a genuine sample equally low in moisture.—W.

TO CORRESPONDENTS.

Richard Weaver.—There is no material improvement in the second edition.

J. L. Sinclair (Auckland).—The specimens of auriferous quartz, together with your letter, have been received, for which please accept our thanks.

W. H. Walenn is thanked for his kind communication.

J. Phin.—We have pleasure in acceding to your request. Your book has been received.

D. T. Hughes.—Received with thanks.

The Secretary of the Royal Society is thanked for his communication.

F. H. T. A.—We should recommend Watts's "Dictionary of Chemistry," (Longmans), £7 3s., Miller's "Elements of Chemistry," 60s., (Longmans), Fownes's "Manual of Chemistry," (Churchill), 14s., Odling's "Outlines of Chemistry," (Longmans), 7s. 6d., Bowman's "Practical Chemistry," (Churchill), 6s. 6d., Bowman's "Medical Chemistry," (Churchill), 6s. 6d., Roscoe's "Elementary Chemistry," (Macmillan), Bloxam's "Laboratory Teaching," (Churchill), 5s. 6d.

J. B. Lippincott and Co.—Received.

W. H. Wood.—Your communication shall receive early attention. It arrived too late for this week.

J. Wilson.—You had better write to the Editor of the *Annales du Genie Civil*. We do not know the address of Dr. Reinsch. Dr. Otto's memoir was in the *Journal of the Franklin Institute*, for January, 1870, which is published in Philadelphia, U.S.A.

BOOKS RECEIVED.

The Chemical History of the Six Days of Creation. By John Phin, C.E. New York: American News Company.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and J. Braithwaite, M.D. Lond. Vol. lxi. January—June, 1870. London: Simpkin, Marshall and Co.

THE CHEMICAL NEWS.

VOL. XXII. No. 554.

PRELIMINARY NOTE ON THE

PREVENTION OF MOULDINESS IN AQUEOUS SOLUTIONS OF TARTARIC ACID.

By WILLIAM H. WOOD,
Middlesbro'-on-Tees.

IN July, 1867, I commenced experiments (which I have continued at various times since, and of which all are still in progress) to determine whether it was possible to prevent the formation of mould which usually occurs in aqueous solutions of tartaric acid a short time after their preparation.

I first tried the addition of creosote, of which I found a single drop effectual in preserving an ounce of solution of 1 part of acid in 2 parts of water.* A week or two since, a friend of mine called my attention to a very similar method of preservation, or prevention, in Bowman's "Practical Chemistry" (5th edition, p. 241), where it is stated, in a foot-note, that the mouldiness "may be prevented by adding a very minute quantity of carbolic acid, which does not interfere with the uses of tartaric acid in analysis."

I do not write to claim priority in the discovery of the above-stated fact, but to make known that, so far, my experiments lead or point to the conclusion that, if a solution of tartaric acid in water, whether mouldy or not, be filtered, and then boiled for a short time (say ten minutes), it will not afterwards become mouldy, whether corked or stoppered up in a bottle, or left exposed to the air.

The details of the various experiments I reserve for a future and longer paper, when I have ascertained the results of several experiments made for confirmation. The statement just made will, in my opinion, if confirmed, be important as bearing on the so-called "spontaneous generation" controversy, and will, I think, throw some light on it. A similar mode of experiment I intend to apply to citric acid and various other substances whose solutions are similarly decomposed. I shall also endeavour to ascertain *the cause* of the non-formation of the mould.

The delay in the publication of the above experimental result arises from the length of time which an experiment of this kind must be in operation before reliable results can be obtained.

June 28th, 1870.

ON THE

FORMATION OF OZONE BY RAPID COMBUSTION.

By O. LOEW,
Assistant in the Chemical Department of the College of the City of New York.†

ACCORDING to the view of Schönbein, every slow oxidation is accompanied by formation of ozone, common oxygen not being able to combine directly with the elements. In 1858, Clausius advanced the hypothesis that ozone is oxygen in the state of *free atoms*, while common oxygen consists *of a molecule of two combined atoms*. But the later investigations of Andrews and Tait, Babo, and Soret, upon the volume of ozone have not supported this notion; and Clausius has modified his hypothesis accordingly, now believing that ozone is a combination between *an atom and a molecule of oxygen*. This combination is but a loose one; and the power of oxidation resides in the third atom of oxygen, which combines directly with other substances, leaving common oxygen behind. This constitution of ozone may be represented by the following formula:—$3([OO]) = 2([OO]O)$.

The oxidation of a metal by ozone is shown by the equation, $([OO]O) + M = MO + ([OO])$.

When we now take into consideration that ozone and antozone together give common oxygen, we must conclude that antozone is oxygen in the state of free atoms. Furthermore, we see that common oxygen can be converted, according to circumstances, either into ozone or antozone. It seemed to me that, in every combustion, even the most rapid and energetic, an intermediate decomposition of the molecule of common oxygen must take place if the single atoms will enter into combination with the elements, and that ozone or antozone would be detected in a flame if the high temperature would not destroy it again as quickly as it is formed.

To prove this conclusion, I blew a strong current of air through a tube, into a flame of a Bunsen's burner and collected the air in a beaker glass or balloon. I was thus able, in a few seconds, to collect enough ozone to readily identify it by its intense odour, and by the common tests.

This observation shows that, not only in slow oxidation, but also in rapid combustion, an intermediate formation of ozone takes place,* and that it can be separated in the proper way.—*American Journal of Science*, vol. xlix., p. 369.

REMARKS ON THE ALKALIES CONTAINED IN THE MINERAL LEUCITE.

By J. LAWRENCE SMITH.

IN examining recently many of the silicates containing alkalies, my attention has been called to leucite, and it is on that mineral especially that I would now remark, reserving for another time my observations on the other silicates.

The specimens of leucite examined came from four localities—Vesuvius, Andernach, Borghetta, and Frescati, They were about as good specimens as are obtained from those localities, although all of them were not equally pure. The alkalies found in each calculated as potash were—

Vesuvius	21·85
Andernach	20·06
Borghetta	20·68
Frescati..	20·38

The specimen from Andernach was analysed for the silica, &c., and found to contain—Silica 54·75, alumina 23·08, and 1·55 of oxide of iron; this last seemed to be mechanically disseminated through the crystals.

I say above in relation to the alkalies "all calculated as potash," for the reason that there is a notable quantity of rubidium and cæsium present in all the specimens above mentioned. In fact, by the method adopted in testing for these alkalies abundant indications are obtainedof the presence of rubidium and cæsium (the last not so readily), even when operating on but ½ a grm. of the mineral. I am now engaged in working out a method of estimating quantitatively rubidium and cæsium in the presence of other alkalies; by this method, not yet perfected, the quantity of these alkalies in leucite is found to be about 9-10ths of 1 per cent of the entire mineral.

Of course it is not at all remarkable that the potash in the different specimens of leucite should be the same; but it is a matter of interest to know that, from whatso-

* Strength recommended in Galloway's "Qualitative Analysis," for analytical purposes.

† Read before the Lyceum of Natural Science, New York.

* Compare the observation of Pincus in the article "On Nitrification," *American Journal of Science*, II., vol. ii., p. 238.

ever locality it comes, this minute quantity of rubidium and cæsium occurs with it. On some future occasion I hope to be able to bring together certain generalities in this connection of more or less interest to mineralogists.

I have also detected rubidium in ½ grm. of margarodite and Warwick mica, and have failed to detect it in apophyllite, Thomsonite, pectolite, elæolite, chesterlite, cancrinite, and other silicates.—*American Journal of Science*, vol. xlix., p. 335.

ON THE

COMPOSITION OF THE ACID-OXALATES OF POTASSIUM, AMMONIUM, AND SODIUM.*

By WILLIAM RIPLEY NICHOLS,
of Boston, Massachusetts.

Binoxalate of Potassium.

THE composition of this salt was formerly held to be expressed by the formula† $KO,C_4O_6+3HO(\dot{C}_2KH\dot{O}_4+aq.)$; and this formula is still given by Gmelin, Watts, and others, as that of the commonly-occurring salt.

Rammelsberg,‡ on the other hand, describes the salt obtained by neutralising a certain quantity of oxalic acid with carbonate of potassium, and adding an equal amount of oxalic acid, as corresponding to the formula—

$$2(KO,C_4O_6)+3aq.[4(\dot{C}_2KH\dot{O}_4)+aq.]$$

Marignac,‖ having afterwards partially analysed this salt, concluded that the correct formula was—

$$C_4KHO_8(\dot{C}_2KH\dot{O}_4),$$

and that the crystals contained no water of crystallisation. He differed from Rammelsberg as to the system to which the crystals should be referred; and the latter afterwards§ acknowledges the correctness of Marignac's views as to the crystalline form, and, without repeating the analysis of the salt, seems satisfied to accept the formula assigned by Marignac.

I have prepared this salt in the manner indicated by Rammelsberg, and find that its composition agrees with the formula originally given by him.

	Calculated.		Found.								
			I.	II.	III.	IV.	V.	VI.	VII.	VIII.	Mean.
$2K_2O$	188·44	35·53	—	—	—	35·55	35·05	—	—	—	35·30
$4C_2O_3$	288·00	54·29	55·35	55·67	55·76	—	—	—	—	—	55·76
3aq...	54·00	10·18	—	—	—	—	—	10·16	10·39	10·58	10·34
	530·44	100·00									

$4(\dot{C}_2KH\dot{O}_4)+aq.$

In these analyses, I determined the potassium as carbonate, by igniting a portion of the finely-powdered crystals in a covered platinum crucible, raising the heat very gradually in order to avoid loss by projection, to which, as Marignac hints, this salt is particularly liable. The oxalic acid was determined by titration with a solution of permanganate of potassium, standardised against pure oxalic acid. The hydrogen was determined by igniting the salt, in a combustion-tube, in a stream of dry air, and collecting the water in a weighed chloride of calcium tube.

RAMMELSBERG'S

	Formula demands.	Own figures were.			
2KO ..	35·53	36·41	..	35·22	35·36
$2C_4O_6$ ..	54·29	55·31	..	54·32	54·00
3aq. ..	10·18	—	..	—	—
	100·00				

MARIGNAC'S

	Formula demands.	Own figures were.
KO	36·78	36·35*
C_4O_6	56·19	55·86
HO	7·03	—
	100·00	

Had Marignac determined the hydrogen in his salt, he would have found his formula to be inadmissible.

In regard to the acid-oxalate described by Graham (*loc. cit.*),† it is extremely doubtful whether there be such a salt. Rammelsberg‡ doubts its existence; and I have myself been unable to procure it. I added to a hot solution of a known quantity of oxalic acid half the carbonate of potassium necessary to neutralise it. The crystals which formed in the hot solution (A), those deposited from the solution at the ordinary temperature (B), as well as those deposited when the solution was artificially cooled to a considerably lower temperature (C), proved to be the quadroxalate, $\dot{C}_2KH\dot{O}_4,\dot{C}_2H_2\dot{O}_4,+2aq.$

	Calculated.		Found. A.			Found. B.		Found. C.
			I.	II.	III.	I.	II.	I.
$K_2\dot{O}$	94·22	18·54	—	—	18·41	18·53	—	—
$4\dot{C}_2O_3$	288·00	56·67	56·23	56·52	—	—	56·86	56·33
$3H_2\dot{O}$	54·00	24·79	—	—	—	—	—	—
4aq. ..	72·00							
	508·22	100·00						

$2(\dot{C}_2KH\dot{O}_4,\dot{C}_2H_2\dot{O}_4,+2aq.)$

In these estimations, the potassium was determined as carbonate, by ignition; and the oxalic acid by titration, as in the preceding case.

I analysed several samples of commercial "binoxalate of potash," but each sample proved to be quadroxalate.

Binoxalate of Ammonium.

This salt was prepared by neutralising a certain quantity of oxalic acid with ammonia-water, and then adding an equal quantity of oxalic acid. Analysis showed the composition of the salt to be $2(\dot{C}_2(NH_4)H\dot{O}_4)+aq.$

	Calculated.		Found. I.	II.	III.	IV.	Mean.
$(NH_4)_2\dot{O}$ ..	52	22·41	—	—	21·54	—	21·54
$2\dot{C}_2O_3$ ..	144	62·08	61·35	61·57	—	—	61·46
$H_2\dot{O}$	18	7·75	—	—	—	—	—
aq...	18	7·76	—	—	—	7·50	7·50
	232	100·00					

$2(\dot{C}_2(NH_4)H\dot{O}_4)+aq.$

The formula usually given in text-books on chemistry (Gmelin, Watts, &c.) is—

$$C_4(NH_4)HO_8+2aq.\dot{C}_2(NH_4)H\dot{O}_4+aq.;$$

that is, with one more molecule of water than I find to be the case. For this formula the calculated percentages would be—

$(NH_4)_2\dot{O}$	52	20·80
$2\dot{C}_2O_3$	144	57·60
$H_2\dot{O}$	18	7·20
2aq	36	14·40
	250	100·00

* From the *Proceedings of the American Association for the Advancement of Science*, 1869.

† On the authority of Graham (*Phil. Trans.*, 1837, p. 50).

‡ *Pogg. Ann.*, vol. xciii., 24 (1854).

‖ *Mém. de la Soc. d. Phys. et d'Hist. Nat de Genève*, t. xiv., Part I. (1855).

§ "Supplement zu dem Handbuch der Krystallographischen Chemie," Leipzic, 1857, s. 81.

* Mean of four.

† Graham deduced this formula from the amount of carbonate of potassium left on ignition (47·45 per cent).

	Calculated.	
KO	32·24	32·34
C_4O_6	49·28	—
3HO	18·48	—
	100·00	

‡ *Pogg. Ann.*, vol. xciii., p. 24 (*supra cit.*)

Anderson* says that the binoxalate of ammonium may obtained by mixing equivalent quantities of chloride of ammonium and oxalic acid (regarded as monobasic, $C_2O_3,HO+2aq.=63$), and gives as the formula—

$$2C_2O_3,NH_4O,2HO[2(C_2(NH_4,HO_4)+aq.]$$

He determined the oxalic acid alone; and, from the data that he gives, it would appear that, instead of the binoxalate, he really obtained the quadroxalate mentioned below.

Percentage of C_2O_3		
In his salt.	In the acid-salt above.	In the hyper-acid salt below.
61·92 ..	62·08 ..	61·80

I found that, by adding a hot solution of 53·5 grms. (1 equiv.) chloride of ammonium (NH_4Cl) to a hot solution of 63 grms. ($\frac{1}{2}$ equiv.) of crystallised oxalic acid ($C_2H_2O_4,+2aq.$), there were deposited, on cooling, crystals of the hyperacid salt of the formula—

$$C_2(NH_4)HO_4,C_2H_2O_4,+2aq.$$

	Calculated.		Found. I.	II.	III.	IV.	V.	VI.	Mean.
$(NH_4)_2O$	52	11·16	11·12	11·29	—	—	—	—	11·29
$4C_2O_3$ ..	288	61·80	—	—	61·14	61·14	61·09	—	61·12
$3H_2O$ ..	54	11·59	—	—	—	—	—	—	—
4aq. ..	72	15·45	—	—	—	—	—	15·81	15·81
	466	100·00							

$2(C_2(NH_4)HO_4,C_2H_2O_4,+2aq.)$

In these analyses, the ammonium was determined as chloroplatinate of ammonium, the oxalic acid by titration, and the water of crystallisation by drying at 100° C. until the weight remained constant.

Binoxalate of Sodium.

Anderson (*loc. cit.*) says that, by dissolving equivalent proportions of oxalic acid (equiv. = 63) and chloride of sodium (equiv. = 58·5) in hot water, crystals of this salt are obtained on cooling the solution. He gives the formula for the same:—

$$NaO,2C_2O_3+4HO[2(C_2NaHO_4)+3aq.]$$

I found that crystals of the binoxalate were deposited from such a mixture, but that they answered to the commonly-received formula—

$$C_4NaHO_8+2aq.[C_2NaHO_4+aq.]$$

	Calculated.		Found. I.	II.	Mean.
Na_2O ..	62 ..	23·85 ..	— ..	— ..	—
$2C_2O_3$ ..	144 ..	55·38 ..	55·19 ..	55·24 ..	55·22
H_2O 2aq. ..	54 ..	20·77 ..	— ..	— ..	—
	260	100·00			

$2(C_2NaHO_4+aq.)$

ON THE

POTASSIO-COBALTIC NITRITE KNOWN AS FISCHER'S SALT, AND SOME ANALOGOUS AND RELATED COMPOUNDS.

By SAMUEL P. SADTLER.

(Continued from p. 10.)

HAVING formed, from these analytical results, our conclusions, let us see if we can find any confirmation of them from other sources. Lang† states that, although the corresponding soda and ammonia salts were probably formed, yet they could not be obtained on account of their solubility. By using a strong $NaNO_2$ solution,* I succeeded in obtaining the new soda compounds which I am about to describe. To a solution of $CoCl_2$, which had been boiled and then acidified with acetic acid, I added an excess of $NaNO_2$ solution. The mixture instantly became of a dark colour, and a yellowish-brown salt began to form, with brisk evolution of nitric oxide. After some hours, when the evolution of gas was progressing but slowly, I added some more of the $NaNO_2$ solution, testing, also, to assure myself that the solution was acid; and, in a little while, the solution began to assume a yellowish colour, and I found a clear, yellow salt depositing. This led to the conjecture that there were two distinct soda-salts. I accordingly sought to obtain them distinct, for analysis. This I found to be difficult. The brown salt I readily got almost pure, but succeeded only partially in obtaining the yellow one distinct. The brown salt continues to form, to a greater or less extent, even after the formation of the yellow one has begun. The preparations were all washed with acetate of soda, which was displaced with alcohol. From analyses of them, and from other and subsequent results, I am led to consider them as salts analogous to Fischer's salt, and differing from each other in the number of atoms of $NaNO_2$ in combination with the Co_26NO_2. The brown salt I would call a *di-sodio-cobaltic-nitrite*, and the yellow one a *tri-sodio-cobaltic-nitrite*; giving them respectively the formulæ—

$$Co_26NO_2+4(NaNO_2)+H2O$$

and

$$Co_26NO_2+6(NaNO_2)+H_2O.$$

$Co_26NO_2+4(NaNO_2)+H_2O.$

	Theor. p. cts.	Found p. cts.	
Co_2O_3	24·13	23·71	23·21
Na_2O	18·02	18·37	18·70
N_2O_3	55·23	—	47·07 (?)†
H_2O	2·62	—	6·66 (?)†

$Co_26NO_2+6(NaNO_2)+H_2O.$

	Theor. p. cts.	Found p. cts.		
Co_2O_3	20·10	20·53	22·04	22·18
Na_2O	22·52	20·70	20·31	19·21
N_2O_3	55·20	—	—	[20·54]
H_2O	2·18	—	—	—

Some error connected with the $CaCl_2$ tube, which I am entirely unable to account for, has here caused an error. It will be observed that in each case the total loss of the combustion-tube is very nearly what the theoretical per cent of H_2O+N would demand, while the increase in the $CaCl_2$ tube is out of all proportion. If we examine the results in the yellow salt, we see that all these preparations are more or less mixtures. The last preparation, indeed, might be put equally under the head of the 2-atom salt, the per cent in brackets showing the per cent Na_2O calculated on the other formula. We are fortunately, however, not dependent solely on these analyses for our evidences of the existence of these two salts. On account of their partial solubility, we are enabled to obtain substitution-compounds from them, which throw very strong light on the composition of the alkali-cobaltic nitrites.

* *Qu. Journ. Chem. Soc.*, vol. i., 231 (1849).
† *Jr. Pr. Ch.*, lxxxvii., 303.

* The KNO_4 and $NaNO_4$ solutions used in this work were prepared as follows:—1 part of nitre and 2 parts of lead were fused together, after Stromeyer's well-known method. After the complete oxidation of the lead, the residue was boiled several times with water. The solution was then filtered, to remove the undissolved litharge. Into the filtrate (which contained more or less free alkali) the red gas evolved from nitric acid and sawdust was passed, until a neutral reaction was obtained. This red gas, however, does not consist of the oxides of nitrogen alone; it also contains some carbonic acid. This throws down, as carbonate of lead, the litharge which had gone into solution. It is now filtered, and the filtrate evaporated to an oily consistency, when the saltpetre in it will almost all crystallise out. We filter it again, and, if we wish it still purer, we can give it the treatment with alcohol described by Hampe (*Ann. Ch. u. Ph.*, 125, 335); this frees it completely from saltpetre, and concentrates it.

† The found percentages of $N+H_2O$ in the brown salt is the average of two determinations.

In one case, after the formation and filtering-off of some of the brown salt, chloride of luteo-cobalt was added to the wine-coloured filtrate, which probably held some of both salts in solution. The strong tendency which luteo-cobalt possesses to form double salts suggested to Dr. Gibbs that some results might be here obtained. A beautiful, yellow, crystalline salt formed and settled quite readily. I then prepared a considerable amount of it, for analysis. It proved to be as good as insoluble in cold water; so that its washing was an easy matter. Its analysis shows very clearly that it was formed from the tri-sodio-cobaltic nitrite, or yellow soda-salt, which existed in the solution, and that 1 atom of luteo-cobalt exactly replaces the 3 of Na_2O, giving it the formula—

$$Co_2,6NO_2+Co_212NH_3,6NO_2+H_2O.$$

$$Co_2,6NO_2+Co_212NH_3,6NO_2+H_2O.$$

	Theor. p. cts.	Found p. cts.
Co_2O_3	32·87	33·04
NH_3	20·20	19·91
N_2O_3..	45·15	44·50
H_2O	1·78	2·37

I now tried chloride of purpureo-cobalt upon some of the same solution, and got a roseo-cobalt compound exactly analogous to that of luteo-cobalt, its formula being $Co_26NO_2+Co_210NH_36NO_2+H_2O$.

The following were the analytical results:—

$$Co_2,6NO_2+Co_210NH_3,6NO_2+H_2O.$$

	Theor. p. cts.	Found p. cts.
Co_2O_3	34·02	33·18

This salt is not nearly as insoluble, however, as the luteo-cobalt salt, and but little of it could be obtained. At first I got it as a yellow and very crystalline salt on the sides of the beaker, after standing some little time. The crystals, examined under the microscope, were beautifully-defined, monoclinic prisms, with terminal planes. The portion I analysed had more of the colour of the salts of roseo-cobalt, and showed, under the microscope, a star-shaped aggregation of small crystals.

I also formed, in the soda-salt solution, a yellowish xantho-cobalt compound, having probably an analogous constitution, but did not get enough of it to analyse. Examined under the microscope, the crystals were seen to be of a peculiar cup-shaped appearance, and quite large and pointed.

The ammonium-salts were next examined. That one, at least, existed had been found by Gibbs and Genth,* although it had not been analysed by them. Erdmann† had, however, formed an ammonium-salt exactly corresponding to Fischer's salt. I succeeded in forming this and another; the two exactly corresponding, in constitution, to the two soda-salts. The circumstances under which the different salts form I am not able, however, to state at all positively, except that, in forming the 3-atom salt, I had more concentrated $CoCl_2$ and NH_4NO_2 solution. They are both bright yellow, and could not be distinguished by their colour. We may term them the *di-ammonio-cobaltic nitrite* and the *tri-ammonio-cobaltic nitrite*, their formulæ being respectively—

$$Co_26NO_2+4(NH_4NO_2)+2H_2O$$
and $$Co_26NO_2+6(NH_4NO_2)+2H_2O.$$

$$Co_26NO_2+4(NH_4NO_2)+2H_2O.$$

	Theor. p. cts.	Found p. cts.
Co_2O_3	24·20	24·09

$$Co_26NO_2+6(NH_4NO_2)+2H_2O.$$

	Theor. p. ct.	Found p. ct.
Co_2O_3	20·39	20·55

Lang is more nearly right in the case of these ammonia-compounds than in regard to the soda-salts, they being much more soluble. I was unable, however, to obtain any substitution-compounds. With this additional light, we are now prepared to draw some conclusions. We find that our luteo-cobalt and roseo-cobalt compounds are exactly analogous to the cobalticyanides of luteo-cobalt and roseo-cobalt formed by Gibbs and Genth,* the only difference being that the monatomic radical NO_2 here replaces the monatomic radical Cy. This, I think, gives us a very strong argument in favour of the exact analogy of the 3-atom soda-salt (and, with it, of Fischer's salt) to the cobalticyanide of potassium, from which the salts of Gibbs and Genth were formed. With this view of these salts, we are able to discern yet other analogies. Iridium forms a number of sesquioxide-salts, very similar to those of cobalt. We have, indeed, two double chlorides of iridium, exactly analogous to the 2-atom and 3-atom soda or ammonia salts. Their formulæ are—Ir_2Cl_6+4KCl and Ir_2Cl_6+6KCl, in which we should expect monatomic Cl to be exactly replaceable by monatomic NO; and so we find that it is. Dr. Gibbs has discovered an iridium-salt, having the formula, $Ir_26NO_2+6(KNO_2)+2H_2O$, an exact analogue of Fischer's salt. Lang† also has discovered a rhodium-salt, whose formula, $Rh_26NO_2+6(KNO_2)$, is precisely analogous. If we place together, for a moment, the three salts in question, their identity of constitution becomes apparent.

Gibbs.

$$Ir_2O_3,3N_2O_3+3(K_2O,N_2O_3) \text{ or } Ir_26NO_2+6(KNO_2).$$

Lang.

$$Rh_2O_3,3N_2O_3+3(K_2O,N_2O_3) \text{ or } Rh_26NO_2+6(KNO_2).$$

Sadtler.

$$Co_2O_3,3N_2O_3+3(K_2O,NO_3) \text{ or } Co_26NO_2+6(KNO_2).$$

If, therefore, we are to place any dependence at all upon analogy, the universal occurrence of the hexatomic Co_2 atom in all our compounds is what we should expect *à priori*. The analyses of the series of salts, I think, fully confirms this expectation.

I have now to discuss some related compounds—those formed in neutral solutions. Erdmann first pointed out the distinction between these and the normal Fischer's salt. He obtained and analysed a yellow "neutral salt." I obtained one corresponding to this, and one of a different ratio. By adding a somewhat dilute solution of KNO_2 to a warm solution of $CoCl_2$, I obtained a highly crystalline precipitate, which was shortly followed by a somewhat crystalline, greenish salt, which was again followed, after some time, by a yellowish precipitate with little or no crystalline character. The appearances were indicative of the successive formation of three protoxide-compounds. This, however, I found, was not the case. The black precipitate, under the microscope, was seen to consist of beautifully-defined cubes of a very dark green colour; and the green precipitate was seen to consist of similar cubes, though much smaller. Analysis afterward proved them to be the same salt in different states of aggregation. On adding a warm concentrated solution of KNO_2, however, to a warm concentrated solution of $CoCl_2$, nothing is formed but a flocculent yellow precipitate, which appears to be the same as that which I formed over mercury in the eudiometer-tube. The formulæ of these salts appear to be as follows:—For the black or green salt, $2(Co_2NO_2)+2(KNO_2)+H_2O$; and, for the yellow salt, $Co_2NO_2+2(KNO_2)+H_2O$. And the first may be termed a *potassio-dicobaltous nitrite*, and the second a *potassio-monocobaltous nitrite*.

$$2(Co_2NO_2)+2(KNO_2)+H_2O.$$

	Theor. p. cts.	Found p. cts.		
CoO ..	30·60	30·65	29·67	30·79
K_2O.. ..	19·22	19·85	21·78	19·87
N_4O ..	46·51	—	—	—
H_2O ..	3·67	—	—	—

* "Researches on Ammonia-Cobalt Bases," p. 48.
† *Jour. Pr. Ch.*, xcvii., 405.

* "Researches on Ammonia-Cobalt Bases," pp. 40 and 18.
† Royal Swedish Acad. Trans., 1864.

$Co_2NO_2 + 2(KNO_2) + H_2O$.

	Theor. p. cts.	Found p. cts.
CoO	22·11	22·08
K_2O	27·77	27·09
N_4O	44·80	—
H_2O	5·31	—

In looking over the analytical data of these analyses of protoxide-salts, we notice a striking similarity between the weights of salt taken and weights of double sulphates obtained. The explanation is very simple, and yet I believe there is involved in it a fact of importance. The similarity of weights is due to the similarity of atomic weights of N_2O_3 and SO_3 (76 and 80) with which the bases are combined. Now, in none of the very many determinations made in the "acid-salts" do we find such a similarity; on the contrary, we find the weight of double sulphates to be invariably less than the weight of salt taken, and in a fixed ratio. The explanation of this is that $Co_2O_3 3N_2O_3$, by digestion with H_2SO, is converted into 2 atoms of neutral $CoSO_4$, and becomes $2(CoSO_4)$. $2CoO,2N_2O_3$ simply assumes SO_3, instead of N_2O_3, and becomes likewise $2(CoSO_4)$. The first loses an atom of NO_2, which the second does not. We have here a strong evidence of the totally different *habitus* of the Co atom in the "neutral" and in the "acid" salts.

(To be continued).

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

Coal-Tar, Benzol, Nitrobenzol, Aniline, and Aniline Purple or Mauve.

In this short course of lectures it is my desire to bring before you a somewhat condensed history of the artificial colouring matters, generally known as the "Coal-Tar Colours." By this designation it is not meant to imply that colouring matters actually exist in coal-tar, and may, therefore, be extracted from it, but that coal-tar is the source of certain products which, when changed by various chemical processes, are capable of yielding coloured derivatives. You will thus perceive that it is important for us to consider the various means employed to obtain the raw materials before giving our attention to the colouring matters themselves. We will, therefore, at once proceed to the consideration of "coal-tar;" its formation and constitution.

Coal-tar consists of the oily fluid formed by the destructive distillation of coal, and is obtained as a secondary product in the manufacture of coal-gas. Originally, coal-tar was a great nuisance to the gas manufacturer, and it was often a problem to him what he should do with it. I need scarcely say that this state of things is now changed. In the gas works the coal is distilled in large retorts, sometimes 25 or 30 feet in length. They are made of fire-clay or iron, and several are arranged in one furnace, or oven, as it is usually termed. Each retort is fitted with an iron mouth-piece, from which a vertical tube rises, the mouth-piece also having a door fastened with a cross-bar and screw.

When in use these retorts are rapidly filled with coal by means of a proper scoop, and then the doors luted and fixed so as to be air-tight. Distillation commences immediately, as the retorts are constantly kept red hot. The gas and other products which form pass up the front vertical pipe (connected with the mouth-piece), through a bend, and down into a long horizontal tube, called the "hydraulic main." Here most of the oily products condense, and as they accumulate pass on with the gas down the general main, and flow into a tank provided for their reception. These oily products constitute "coal-tar." The coal-gas, leaving this tar behind, passes on to the condensers, and deposits a second but smaller quantity of tar, and is then purified and stored in the gas-holders. The gas, however, does not interest us now.

I am here distilling some coal in a small glass retort, the beak of which is inserted into one of the openings of a three-necked receiver. The second opening is connected with the tube, so that the gaseous products may be examined, whilst the third and lower one is fitted to a small bottle, in which you see we have already obtained a quantity of an oily fluid. This is our coal-tar.

Having now seen how coal-tar is produced, we will consider of what it consists. Coal-tar is by no means a definite body, but contains a great number of different substances, as a glance at the following table will show:—

TABLE I.—PRODUCTS OF THE DISTILLATION OF COAL.

Name.	Formula.	Boiling-point. Centigr.
Hydrogen	HH	—
Marsh gas (hydride of methyl)	$(CH_3)H$	—
Hydride of hexyl	$(C_6H_{13})H$	65
Hydride of octyl	$(C_8H_{17})H$	106
Hydride of decyl	$(C_{10}H_{21})H$	158
Olefiant gas (ethylene)	C_2H_4	—
Propylene (tritylene)	C_3H_6	—
Caproylene (hexylene)	C_6H_{12}	55
Œnanthylene (heptylene)	C_7H_{14}	99
Paraffin	C_nH_n	—
Acetylene	C_2H_2	—
Benzol	C_6H_6	80·8
Parabenzol	C_6H_6	97·5
Toluol	C_7H_8	110
Xylol	C_8H_{10}	139
Cumol	C_9H_{12}	148·4
Cymol	$C_{10}H_{14}$	170·7
Naphthalene	$C_{10}H_8$	212
Paranaphthalene (anthracene)	$C_{14}H_{10}$	—
Chrysen	C_6H_4	—
Pyren	$C_{15}H_4$	—
Water	$\left\{\begin{matrix}H\\H\end{matrix}\right\}O$	100
Hydrosulphuric acid	$\left\{\begin{matrix}H\\H\end{matrix}\right\}S$	—
Hydrosulphocyanic acid	$\left\{\begin{matrix}H\\(CN)\end{matrix}\right\}S$	—
Carbonic oxide	CO	—
Carbonic anhydride	CO_2	—
Bisulphide of carbon	CS_2	47
Sulphurous anhydride	SO_2	—10
Acetic acid	$\left\{\begin{matrix}H\\(C_2H_3O)\end{matrix}\right\}O$	120
Carbolic acid (phenol)	$\left\{\begin{matrix}H\\(C_6H_5)\end{matrix}\right\}O$	188
Cresylic alcohol (cresol)	$\left\{\begin{matrix}H\\(C_7H_7)\end{matrix}\right\}O$	203
Phlorylic alcohol (phlorol)	$\left\{\begin{matrix}H\\(C_8H_9)\end{matrix}\right\}O$	—
Rosolic acid	$C_{12}H_{12}O_3$	—
Brunolic acid	—	—
Ammonia	$\left\{\begin{matrix}H\\H\\H\end{matrix}\right\}N$	—33
Aniline	$\left\{\begin{matrix}(C_6H_5)\\H\\H\end{matrix}\right\}N$	182
Pyridine	$(C_5H_5)'''N$	115
Picoline	$(C_6H_7)'''N$	134
Lutidine	$(C_7H_9)'''N$	154
Collidine	$(C_8H_{11})'''N$	170
Parvoline	$(C_9H_{13})'''N$	188
Coridine	$(C_{10}H_{15})'''N$	211
Rubidine	$(C_{11}H_{17})'''N$	230
Viridine	$(C_{12}H_{19})'''N$	251
Leucoline	$(C_9H_7)'''N$	235
Lepidine	$(C_{10}H_9)'''N$	260
Cryptidine	$(C_{11}H_{11})'''N$	256
Pyrrol	$(C_4H_5)'''N$	133
Hydrocyanic acid	HCN	26·5

* The Cantor lectures, delivered before the Society of Arts.

This list, however, does not indicate all the constituents of coal-tar, but only those which chemists have, up to the present time, succeeded in separating from it; moreover, when we consider how greatly coal differs in composition, and also that the products vary according to the temperature to which the coal has been submitted, it is evident that coal-tar must be an almost endless source of chemical products. Many would, perhaps, consider this list a perfectly hopeless jumble of names impossible to impress upon the memory; but, fortunately, chemists are able to classify their products, so that this formidable array of substances may be grouped under three or four different heads only, and, therefore, their relationship being once understood, little difficulty is experienced in remembering their names.

Amongst these products, and at the lower part of this table, you will observe a substance called "aniline." This substance is of great interest to us, being one of the principal sources of the coal-tar colours. Aniline was discovered by Unverdorben, in 1826, amongst the products of the distillation of indigo, and from its property of forming crystalline compounds with acids was called "crystalline." Afterwards Runge obtained it from the distillation of coal, and, because it gave a blue colouration with a solution of chloride of lime, called it "kyanol," or blue oil. Fritzsche, still later, obtained aniline by the distillation of indigo with hydrate of potassium, and gave it its present name, derived from *anil*, the Portuguese for indigo. About this time Zinin discovered a remarkable reaction, by which he obtained aniline from a substance called nitrobenzol; he called it, however, benzidam. The products obtained by these different chemists were not at first known to be identical; and it was not until Dr. Hofmann investigated the subject that they were all shown to be the same body, aniline.

Zinin's process for the conversion of nitrobenzol into aniline consisted in treating the nitrobenzol with an alcoholic solution of sulphide of ammonium; this was greatly improved upon by Bechamp, who employed a mixture of finely-divided iron and acetic acid, in place of sulphide of ammonium.

This is a brief sketch of the history of aniline up to the time of the discovery of the mauve dye; it was then purely a laboratory product, and was prepared in very small quantities at the time, and only when required for scientific research. Chemists have always been desirous of producing natural organic bodies artificially, and have in many instances been successful. It was while trying to solve one of these questions that I discovered the "mauve." I was endeavouring to convert an artificial base into the natural alkaloid quinine, but my experiment, instead of yielding the colourless quinine, gave a reddish powder. With a desire to understand this peculiar result, a different base of more simple construction was selected, viz., aniline, and in this case I obtained a perfectly black product; this was purified and dried, and when digested with spirits of wine gave the mauve dye.

You will perceive that this discovery did not in any way originate from a desire to produce a colouring matter, as is sometimes stated, but in experiments of a purely theoretical nature.

After showing this colouring matter to several friends, I was advised to consider the possibility of manufacturing it upon the large scale, and was eventually, induced to make the experiment, though, I must confess, not without considerable fear of the result, especially as my chemical advisers set before me anything but encouraging prospects. In starting this manufacture, the first difficulty was to decide upon the source from which aniline could be obtained at a sufficiently low price. It was at once evident that indigo was by far too costly a product for this purpose. Attention was, therefore, directed to the extraction of aniline from coal-tar, but after very numerous experiments, it was found that the difficulty of purifying it was so great, that it was not practicable to prepare it at a reasonable price from this product. There was, therefore, but one source left, namely, nitrobenzol; but to prepare aniline from this body necessitated the establishment of a new manufacture; nitrobenzol at that time not being a commercial article, and although it could be produced in small quantities without much difficulty, yet when tons were required at a limited cost many obstacles presented themselves.

Having spoken of nitrobenzol, it will be necessary, before proceeding further, to tell you something of the body it is prepared from, and also how it is made in quantity. Nitrobenzol is produced from a derivative of coal-tar called benzol—you will see it mentioned in the list of coal-tar products. It is composed exclusively of carbon and hydrogen, and is, therefore, called a hydrocarbon.

Benzol was discovered by Faraday, in 1825, one year before aniline by Unverdorben. Its existence in coal-tar was first pointed out by Dr. Hofmann, in 1845, and afterwards Mansfield showed that an almost unlimited supply might be obtained from this source. Benzol is a volatile oil, boiling at a temperature of 80·8°C., nearly 20° lower than water, and is also very inflammable, burning with a smoky flame, When ignited it cannot be extinguished by water, as it floats upon its surface. Its vapour, when mixed with air, is explosive. It is also very dense. This I can easily show you by decanting a small quantity of benzol vapour several times from one vessel into another, and then igniting it. Instances have been known, when distilling benzol in large quantities, and some leak in the apparatus has occurred, so that its vapour has escaped, that it has run along the ground, and been ignited by a furnace situated thirty or forty feet distant, and instantly run back to the apparatus, To illustrate this I will pour some benzol vapour into the top of a slightly inclined trough, fourteen feet long, at the lower end of which is placed a lamp. The vapour will be seen to run gradually down till it reaches the lamp, where it ignites and instantly rushes back to the top of the trough. One of the most remarkable properties of benzol is, that when cooled down to nearly the freezing point of water, it solidifies to a beautiful crystalline mass. This property of benzol is sometimes taken advantage of when it is required in a very pure state, as the impurities which accompany it are fluid, and do not freeze when cooled with ice.

Benzol is often sold under the name of benzine collas, for the purpose of removing grease from wearing apparel. But let us consider how benzol is separated from the great number of products with which it is associated in coal-tar. The first operation consists in distilling the coal-tar, just as it comes from the gas-works, in large stills, holding one or two thousand gallons each; these are often made of old steam-boilers; at first very volatile and light oily products come over, and are collected until their density increases to such an extent that they no longer float upon water. These constitute crude coal-tar naphtha. The distillation is then carried on, and heavy, or, as they are technically termed "dead," oils, are collected, a residue of common pitch being left in the still. This pitch is generally run out, and cast into blocks; but sometimes the distillation is carried on after the dead oils have been obtained, when a mixture of solid oily products distils, nothing but a kind of coke being left behind. These latter substances, however, do not interest us now.

The light oil, or crude coal-tar naphtha, is then purified by one or two alternate distillations with steam and treatments with concentrated sulphuric acid. It is thus rendered a colourless fluid. Thus purified, coal-tar naphtha contains, besides benzol, at least four or five other bodies. These, however, mostly differ from benzol in being less volatile; therefore, the naphtha is again distilled, the first, or more volatile, portions only being collected for benzol. By repeating this process of fractional distillation several times, commercial benzol is obtained. Some manufacturers employ stills of a peculiar construction, which enables them to obtain a good product

by a smaller number of distillations. Benzol, when treated with fuming nitric acid or aquafortis, undergoes a remarkable change. At first the two fluids mix and become of a dark brown colour and slightly warm, in the course of a few moments red fumes appear, and the mixture enters into ebullition. During this violent action the colour of the liquid becomes lighter and ultimately changes to orange. If water be now added to this product, the benzol, which is such a light body, will be seen to have completely changed into a dense yellow oil sinking in water. This oil is nitrobenzol. Nitrobenzol was discovered in 1834, by Mitscherlich. It solidifies into a crystalline mass at a temperature of about 3° C.; its odour is like that of the oil of bitter almonds, and before the introduction of coal-tar colours it was made in small quantities, and sold under the name of essence de Myrbane, for the purpose of scenting soap.

From the energy with which benzol is attacked by fuming nitric acid, nitrobenzol at first appeared to be a most difficult product to manufacture on the large scale, and this difficulty seemed the greater when it was found necessary that it should be made at a moderate cost. Moreover, at the time I am now referring to, fuming nitric acid, sp. gr. 1·5, could not be obtained in the market, or only at such a cost as almost to preclude its use. Under these circumstances, two mixtures were experimented with instead of the nitric acid in a very concentrated condition. The first was a mixture of nitrate of sodium and sulphuric acid, the second a mixture of ordinary nitric acid, sp. gr. 1.3, and sulphuric acid. The mixture of sulphuric acid and nitrate of sodium was preferred, and employed on the large scale.

(To be continued.)

NOTICES OF BOOKS.

On the Manufacture of Beet-Root Sugar in England and Ireland. By WILLIAM CROOKES, F.R.S., &c. Illustrated with Ten Engravings. London: Longmans, Green, and Co. 1870.

WHILE we cannot, for obvious reasons, pronounce an opinion on the merits or demerits of this book, we may perhaps be allowed to say that the author's aim has been to give, in a convenient-sized volume, all the information and statistics necessary for the culture of the beet and the establishment of beet-sugar manufactories.

The subjects treated of are:—The Culture of the Beet; Technology of the Beet-Sugar Manufacture; the Chemistry of Beet-Root Sugar, Juice and Molasses; Filtration and Concentration of the Juice; Decolourising the Syrup; Water Supply; the Concreting Process; the Utilisation of the Spent Beet-Root Pulp; the Manufacture of Spirit from Beet-Juice; the Sucrate of Lime Process; Manufacture of Potash Salts; Excise Regulations; Percentage of Sugar in Different Kinds of Beet; Yield per Acre; Description of Dr. C. Schiebler's Calcimeter, or Apparatus for the Quantitative Estimation of the Carbonate of Lime in Bone-Black by Volumetrical Assay.

It is certainly a cause for astonishment that a country ranking high in agriculture, and highest in everything relating to manufacturing appliances, should have hitherto kept far behind Continental agriculturists in the successful prosecution of this industry; a fact the more to be wondered at since the spent beet-root pulp is even a better food for cattle than the root crops so extensively cultivated for that purpose. Excepting the central and northern parts of Scotland, and the high moor-grounds, the United Kingdom is as favourably situated for the cultivation of the sugar-beet as any portion of the European Continent; whilst the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing systems of rotation. That agricultural labourers can be readily taught the routine of the manufacture is evidenced by Continental experience; and the skilled supervision does not require more than, at the utmost, half a dozen men.

The Chancellor of the Exchequer, in his recent speech on the Budget, when introducing the subject of the partial remission of the sugar duties, said:—"We know that the beet-root industry of the Continent seems to have got over its difficulties, and to be spreading very widely. There is also the prospect of the growth of beet-root, with this object, in our own country; and, if we could hope for anything so good as that it should be introduced with success into the south of Ireland, it would be one of the greatest blessings that could possibly befal that country." The sugar-beet has been grown experimentally in various parts of the county of Kilkenny, by the Hon. L. Agar Ellis, M.P.; and the important result has been established that the climate of the south-east of Ireland is suitable for the growth of such a crop, and that sugar-beet can there be grown of a quality which will remunerate the manufacturer. It is calculated that a proportion of 8·5 of crystallisable sugar will pay; and, in some instances, comprised within the range of the experiments, there was a yield of 10·91 and of 8·94. Mr. Ellis observes that, to make the crop worth growing, either the present sugar-refiners of Ireland must put up machinery for "converting" it, or separate districts must erect the necessary works. That the magnitude of the industry is sufficient to warrant operations on the largest scale is shown by the fact that last year France alone produced no less than 300,000 tons of beet-sugar, which, at £25 per ton, would be worth £7,500,000, the molasses (100,000 tons at £5) bringing up the value to £8,000,000. Beet-root may yet redress the injury inflicted on Ireland by the potato.

As some remarks were recently made in our journal respecting Dr. Schiebler's calcimeter, we propose, in our next number, to give a full description of the instrument, together with the woodcut as it appears in the above work.

Abridgments of Specifications Relating to Aëronautics. A.D. 1815—1866. London: Messrs. Spottiswoode. 1869.

WITH indefatigable zeal the gentlemen who are the active workers under the Commissioners of Patents proceed in the laudable work of compiling and publishing the series of useful works, of which the above is the forty-first already issued for public use.

The little volume before us is especially interesting, because the introduction contains the history of aëronautics, set forth in a lucid and clear manner, so as to show the connecting-links that bind together the history of this subject.

After referring to the ideas expressed in the fables of the Ancients, and the accounts of Icarus and Dædalus, to show that mankind always had in view the possibility of elevating themselves in the air, the author says:—"The term aëronautics is rather in advance of the condition of the subject at the present day, since no means are known by which a heavy body may be elevated into the air, and navigated as a ship is on the sea. The utmost that has been done is to take advantage of the different aërial currents that exist at a given time at various elevations, and, by raising and lowering a gas-balloon accordingly, to approximate to the desired direction. The various methods (many proposed, and a few realised) that have the accomplishment of aërial navigation for their object may be classified thus:—Kites; fire-balloons; hydrogen-balloons; coal-gas balloons; mechanical apparatus."

The author next briefly alludes to the history of each of the matters just specified, calling attention to the very great antiquity of the use of kites for amusement among the Chinese and Japanese; and explains the term fire-balloons from the well-known fact that the ascent of these balloons is due to the rarefaction of the air caused by

the fire which is kept burning beneath them. This is effected usually by a sponge dipped in strong spirits of wine. This mode of letting up balloons, having become rather a general amusement on some parts of the Continent, was forbidden by the authorities, on the ground that the falling-down of these fire-balloons (which often became ignited, and burst into flames) gave rise to fires, especially in country districts. The mechanical means of flight is at present only represented by a toy called the "aërial top," which has light, but strong, blades attached, at a certain acute angle, to its axis.

We next meet with a brief chronological summary of the history of this subject, beginning with Archytas (400 B.C), who constructed a wooden pigeon which could fly by mechanical means, up to our day, relating Mr. J. Glaisher's researches. This summary aims at the registration of scientific data, not a collection of ascents; and is, therefore, of very great value. Attention is drawn to the very complete series of works on aëronautics, accessible to the public, at the Patent Office Library; and, among these, to a most valuable manuscript work, entitled, "Aëronautica Illustrata," an extensive and valuable collection of writings, illustrations, and original documents that have been collected and arranged in the course of years.

Space forbids us to enter into more particulars; but the compiler and the author of the introduction to this neat little volume deserve great credit for their work. And, since the price (sixty pages) is only 4d., we abstain from further details, but recommend the volume, not only for amusing, but also for instructive, reading.

CORRESPONDENCE.

ERECTING PRISM.

To the Editor of the Chemical News.

SIR,—Referring to Mr. Browning's reclamation in the CHEMICAL NEWS, vol. xxi., p. 264, in which he mentions that he made one of these prisms "two or three years since," allow me to mention that a full account of the arrangement (in fact, the article published in the CHEMICAL NEWS, vol. xxi., p. 246), appeared in the *Journal of the Franklin Institute*, for June, 1867.

The prism had been exhibited at the meeting of the Institute in the previous month and was made some time before,* so that, taking the earliest of Mr. Browning's dates, this is another of those remarkable instances of coincidence in ideas regardless of distance which are so often met with.

HENRY MORTON.

MISCELLANEOUS.

University of London (D.Sc. Examination).—Branch I. *(Mathematics)*—John Hopkinson, Trinity Coll., Camb., and Owen's. Branch IV. *(Inorganic and Organic Chemistry or Mineralogy)*—James Bottomley, B.A, Owen's College; David Watson, Royal School of Mines; John Watts, private sudy. Branch V. *(Organic and Inorganic Chemistry)*—James Campbell Brown, Royal College of Chemistry and private study; Charles Romley Alder Wright, Owen's College. Branch VIII. *(Physical Optics, Heat, Acoustics)*—John Hopkinson, Trinity Coll., Camb., and Owen's.

Royal School of Mines.—After a meeting of the Council, held on Saturday, the 2nd inst., the results of the examinations for the year were announced as follows:—*Third Year's Students*—Associates in Mining, Messrs. W. Gowland, Archibald Liversidge, and H. J. Renwick; in Metallurgy, W. Gowland, Dillon, Liversidge, W. W. Bickerton, F. W. Bailey, and T. Jones; in Geology, W. Johnson Sollas. Medals—De la Beche Medal and Prize of Books to W. Gowland. *Second Year's Students*—H.R.H. Duke of Cornwall's Scholarship of £30 for two years, to P. C. Gilchrist; Royal Scholarship, £25, for one year, to R. R. Atkinson; Sir Roderick Murchison's Medal and Prize of Books, to P. C. Gilchrist. *First Year's Student*—Royal Scholarship of £15, for one year to (1.) W. H. Greenwood, and (2.) F. C. Mitford.

The Franklin Institute.—At a recent meeting of this Institute, Professor Morton resigned the office of Resident Secretary, he having accepted an appointment in a distant city. The resignation was accepted, and the President stated that Professor Morton had consented to continue his charge of the *Journal of the Franklin Institute*, which had achieved so desirable a position under his management. The new position accepted by Professor Morton is that of President of a College of Mechanical Engineering, to be established in Hoboken, opposite New York. He is succeeded at the Institute by Dr. W. H. Wahl.

Magic-Lantern Pictures on Gelatine by a New Method.*—At the last meeting of the Franklin Institute, the Resident Secretary, Professor Morton, exhibited in the lantern some pictures on gelatine, prepared in a manner devised by Mr. Sheperd Holman, a member of the Institute. For this purpose a sheet of gelatine, such as is used for tracing by engravers, was securely fixed over an engraving, and with a sharp steel point (made by grinding down the end of a small round file), the lines of the original traced pretty deeply on the transparent substance. Lead-pencil or crayon dust was then lightly rubbed in with the finger, and the picture was at once ready for use. A number of such drawings could be easily carried between the leaves of a book, each in succession being held in a frame or cell made of two plates of glass separated by a frame of thin card or three edges, and united by paper or muslin pasted around the same edges. The effect of these drawings in the lantern was excellent, and their ease of production very great.—*Journal of the Franklin Institute.*

A New Artificial Light.—The *Berggeist* describes a new artificial light which has recently been successfully experimented with. It is the Philipp carbo-oxygen lamp, and its trial during the month of March, at Cologne, was such as to win approval on every hand. The system of lighting is distinguished from those already in existence by its simplicity, its brilliancy, and, moreover, by its less noxious character. The light is generated by the simultaneous combustion of a liquid chemical compound and a current of oxygen, arrangements for the purpose being constructed in a suitable lamp. The gas is derived from the atmosphere either by chemical or mechanical means; the chemical methods being to act upon the oxygen of the air with chloride of copper (Mallett's method), or with manganate of potash (Tessie du Mothay's method), while the mechanical mode is that of utilising the different degrees of solubility of nitrogen and oxygen in water or other liquids. By compressing atmospheric air into receivers filled with water, a portion of the nitrogen is taken up by the water, while the oxygen remains insoluble in the water; the air, thus containing a goodly proportion of oxygen, is forced into a second reservoir of water, where a further amount of nitrogen is absorbed, and after the operation has been repeated seven or eight times, an atmosphere is obtained containing 97 per cent of oxygen. The nitrogen which has been separated is made use of in a well-constructed apparatus, as an auxiliary to the motive force. Experiments have established the fact that a flame fed with air containing 53 per cent of oxygen

* The charges against me on Mr. Zentmayer's books for the prism then used being dated March, 1867, while a smaller one, not charged, was made some months before.

* Communicated by Professor Morton.

yields a light equal in brilliancy to that obtained with pure oxygen, and with diluted oxygen of this kind the Philipp flame has a brilliancy of 90 to 100 candles, or ten times that of an ordinary gas jet. The light is of a bluish white, resembling very much that of electricity and magnesium. The liquid employed consists of liquid hydrocarbons, very rich in carbon; it costs but little, burns economically, and can be employed only in this particular direction. The combustion is maintained in a lamp—Philipp's carbo-oxygen lamp—fitted with a wick, into the flame of which the oxygen penetrates in a horizontal direction. The flame is thus made to assume the form of a star, and any heating of the wick-holder thereby prevented; if of the size and power above mentioned, the quantity of gas consumed is 5½ cubic feet per hour. As to the lamp, no special attention is necessary beyond that of filling it with liquid, as the wick is of a very durable nature, and needs no trimming. The hydro-carbon employed is patented both in Europe and in America. This method of lighting is, we believe, likely to be adopted very widely. Independently of its simplicity and reasonable cost, which are, indeed, extreme, it possesses the very eminent and valuable qualifications of perfect security; no explosion is in any way possible, such as not unfrequently occurs with ordinary coal gas and with hydrogen. The costly trials undertaken by Tessie du Mothay, inaugurated at the exhibition of 1866, made a profound sensation at the time, and were regarded with considerable favour, although the apparatus employed was of a very costly description, and it was necessary to employ for the purpose two gases exceedingly dangerous to manipulate, which were brought through a double series of tubes, the one for ordinary gas, and the other for oxygen; the apparatus itself, moreover, necessitated a careful and continued superintendence. All these inconveniences disappear with the new carbo-oxygen system, which, besides its application to industrial purposes—the navy, railways, military operations, &c.—will be wonderfully well suited to photographic purposes, as has, indeed, been proved by the attainment of some very remarkable results. The *Berggeist* concludes by saying that a method of lighting endowed with such important qualifications as the lamp invented by M. Philipp cannot remain long before being extensively known throughout the world.—*The Photographic News.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, June 20, 1870.

Omitting papers more strictly bearing upon mathematical, natural history, and mechanical subjects, this number contains the following papers and memoirs relating to physico-chemical science:—

Variations of Temperature Produced by the Mixing of Two Different Liquids.—M. Jamin.

Observations and Remarks on this Memoir.—J. Bussy.—The contents of these papers are chiefly speculative; and, as regards the latter paper, the author points out several discrepancies which exist between the results obtained by his experiments on this subject, and those of the first-named author.

Electric Effects Produced by the Contact of Non-Oxidisable Metals with Acids, Neutral and Saturated Saline Solutions, and on Capillary Affinity.—Prof. Becquerel.—In this paper, only published in abstract, the author describes the electric phenomena observed when pure gold and platinum are immersed in various acids, ammonia, and neutral saline solutions, which do not exercise any action at all upon the metals alluded to. The main conclusion arrived at by the author is, that the state of the surface of the metals has great influence, and that, consequently, capillary affinity plays a very important part in the production of the electric phenomena (very feeble currents) produced.

Reversal of the Two Lines of Sodium in the Spectrum of the Light Produced by one of the Protuberances of the Sun.—G. Rayet.—Illustrated with diagrams.

Estimation of the Absolute Value of the Intensity of the Terrestrial Magnetism.—A. Cornu and J. Baille.

Experimental Researches on the Length of Duration of the Electric Spark.—MM. Lucas and Cazin.—The authors employ two transparent discs placed upon the same axis. One of these discs is a fixture, while a more or less rapid rotatory motion can be imparted to the other. Upon both discs are painted the same number of opaque stripes, in the direction of the radius. When, therefore, an electric spark is observed through these discs, a certain amount of speed having been imparted to the movable one (the apparatus being placed in a darkened room), it is clear that, by the light emitted by the spark, a certain number of coincidences of the movable and fixed stripes may be observed, and these coincidences may serve to calculate the period of duration of the spark.

Precipitation of Muddy Matter from Water by the Aid of Dilute Saline Solutions.—Dr. Ch. Schlœsing.—The author states that water, otherwise pure, but contaminated simply with clay (as may be the case with the water of rivers after heavy rain or fall of snow), becomes at once clarified by very minute quantities of some salts of lime. 1-1000th part of chloride of calcium for 1 part of water effects this purpose in a moment; the nitrate, bicarbonate, and caustic lime act in the same manner. The precipitated substance may be readily separated from the water by filtration, whereas the filtration of the water containing the suspended matter is very difficult, because the pores of the filters are choked. The practical importance of this matter is very great, since it is, for instance, a well-known fact that the water of some rivers (the Durance being notorious in this respect) does not, in winter time, and after heavy rainfall or snow-storms, become quite clear, even if left at rest in large ponds for a considerable time. The same is the case with the water of the Rhine, which, in its lower course, is often quite turbid for weeks together, simply from the effects of very finely-divided clay being kept suspended, even after the water has been at rest in tanks. The water of the river Durance supplies Marseilles with fresh water, the latter being brought to that city by a magnificent series of works, among which the celebrated Aqueduc de Roquefavour. The use of chloride of calcium is, however good, not indispensable; and our readers may be reminded here that the late Prof. Johnston, of Durham University, has very ably and fully explained the clearing of muddy, and thereby non-potable, water in his work, "Chemistry of Common Life," wherein he has also made reference to the use of certain bitter vegetable substances which have been applied, both in Egypt and in India, for the purpose of rendering the waters of the Nile, Ganges, Indus, and other large rivers, potable, many centuries before the *rationale* of the action of these substances was understood.

Law of Freezing-Points of Saline Solutions.—Dr. Güldberg.—An algebraico-physico-chemical essay.

Composition of Crude Soda; and on the Loss of Sodium resulting from its Manufacture according to Le Blanc's Process.—A. Scheurer-Kestner.—Although we reserve this highly-important paper bearing upon the manufacture of soda for full translation at a future date, we here quote that, while it is a well-known fact that, in practice on the large scale, a loss of from 15—20 per cent from the theoretical yield is experienced, the author has ascertained that the main cause of this loss (some of these causes are well known already) is the formation of insoluble (in water) sodic combinations, which remain in the lixiviated refuse. Volatilisation of sodium does not take place appreciably.

Rapid and New Method of Quantitative Estimation of Ammoniacal Salts; on the Causes which Prevent the Existence of these Salts in the Human Organism in other than Infinitesimally-Small Quantity.—Dr. Rabuteau.—The author prepares a solution of eau de Javelle (*chlorure de soude*, strictly a more or less pure hypochlorite of soda), by mixing, with a solution of 1 part of bleaching powder (hypochlorite of lime), a solution of 2 parts of carbonate of soda. The solution so obtained, containing, besides, excess of carbonate of soda, or free soda, is applied for the decomposition of the ammoniacal salts, so that nitrogen is set free. The remainder of the contents of this paper is strictly physiological, and the intention, as regards the application of the test liquid, is for the use of physicians in practice more than for the chemist.

Tribromhydrines.—Dr. Berthelot.—A lengthy menoir containing a series of critical remarks and observations on the last paper on this subject, by Dr. Henry, published in this periodical.

Preparation of Bibromated Ethylen.—Dr. Fontaine.—After referring, at great length, to the labours of several experimenters on this subject, and pointing out the incompleteness of their modes of preparation of the body alluded to, the author states that bibromated ethylen may be obtained without any evolution of gas, by pouring into bromated bibromide of ethylen, $C_2H_2Br.Br_2$, kept well cooled, an alcoholic solution of caustic potassa, care being taken to avoid any increase of temperature. As soon as the liquid has become thoroughly alkaline, water is added, and the bibromated ethylen separated by decantation.

On an Aromatic Glycol.—E. Grimaux.—The author of this long

paper describes the reactions by means of which he has succeeded in obtaining the tollylic-glycol—

$$C_8H_8(OH)_2 = C_6H_4 \begin{cases} CH_2OH \\ CH_2OH \end{cases}$$

This body fuses at about 113°; is very soluble in water, alcohol, and ether; and crystallises in needles. Heated with hydrochloric acid, it is converted into chloride of tollylen.

Dust- and Blood-Rains.—H. Tarry.—A very lengthy and interesting memoir on this subject, proving the true origin of these phenomena.

Notes relating to the Magnetic Perturbations observed by De Saussure while Sojourning on the Col du Géant, which Perturbations preceded the Terrible Hail- and Thunder-Storms which occurred during the year 1788.—C. Dufour.—The Col du Géant, at 3426 metres above sea level, is a portion of the Alps. The author of this paper calls attention to the relation which appears to have existed, but was not (as far, at least, as his own records prove) observed or noticed by the late De Saussure, between the severe perturbations of the magnetical instruments he had with him at the locality alluded to, and the exceedingly severe hail- and thunder-storm which followed the very next day (July 13th, 1788) of these perturbations, over a large portion of Europe, from the north of Spain to the Baltic. The author of this paper calls attention to these old observations (the Aurora Borealis was also seen faintly at the Col du Géant at the time); because, as noticed this year, the phenomenon last alluded to was immediately followed by several *bourrasques* bursting over Europe. By bourrasques are meant severe perturbations of the air, often accompanied by hail, thunder, heavy rains, and always high wind, if not, in some localities, hurricane.

June 27, 1870.

This number contains the following memoirs and papers bearing upon chemistry and collateral sciences:—

Observations and Remarks on M. Jamin's Paper "On the Variations of Temperature Produced by the Mixture of Two Liquids."—H. Sainte-Claire Deville.—The author, pursuing his course of combating hypothesis, attacks, in this paper, several of the statements made by M. Jamin, and especially points out the perfect uselessness of the idea of an absolute zero to explain the phenomena relating to the specific heat and free caloric.

Researches on some New Derivatives from Triethyl-Phosphine.—A. Cahours and H. Gal.—After referring to their former researches on this subject, the authors describe several new compounds of triethyl-phosphine and chloride of platinum, among which we notice a body composed according to the formula, $[Ph(C_4H_5)_3]_3PtCl$, a prismatically-crystallised, colourless substance, corresponding to Reiset's salt, $(NH_3)_3PtCl$. The triethyl-phosphine compound alluded to is decomposed at 100°, losing one equivalent of triethyl-phosphine. The authors have also produced compounds of the chlorides of gold and palladium with triethyl-phosphine, which, according to their researches, act towards the chlorides alluded to in a manner akin to the behaviour of ammonia with these chlorides.

Galvanical Deposition of Nickel.—H. Bouillet.—The author states that the assertion of M. Adams, in reference to the necessity of having the nickel solution absolutely free from alkalies and alkaline earths, is quite incorrect; and, in proof thereof, the author exhibits a perfectly coherent piece of nickel, obtained by Professor Jacobi, of St. Petersburg, from the double sulphate of nickel and magnesia, by the use of a nickel anode, which, curiously enough, is not entirely dissolved, but converted into a spongy suboxide of nickel.

Direction of Induction Currents obtained by the aid of Electrical Discharges.—J. Chautard.

New and Generally-Applicable Method for the Preparation of Organic Chloro-Bromated Compounds.—L. Henry.—The author states that, having read of Dr. Friedel's researches on the preparation of chlorobromides of the biatomic hydrocarbons, he has made some experiments with the chloro-iodide of ethylen, $(C_2H_4)ICl$, and with the chloro-iodhydrine of allyl, $(C_3H_5)(HO)ICl$, which, by the action of bromine, are converted into chloro-bromated compounds. The author continues his researches on this subject.

Silico-Propionic Acid.—C. Friedel and A. Ladenburg.—While organic chemistry is aptly called (say the authors) the chemistry of carbon, we are engaged in researches which tend to place silicium parallel to the former element. What is called silico-propionic acid, $SiC_3H_5O_2H$, is a compound wherein a large percentage of the carbon of propionic acid is replaced by silicium. The physical aspect, and many of the properties of this body, are akin to silica; but it is a combustible substance, insoluble in water, but soluble in a hot and concentrated solution of caustic potassa. M. Dumas observed, during the meeting, at which this paper was read, that it is not impossible that there exist in nature organic compounds of silica, a remark which gave rise to the following paper:—

Observations on Dr. Friedel's Memoir.—P. Thenard.—The author begins with stating that M. Dumas is quite right, and relates, further, that he (M. Thenard) is at present engaged on researches of organic acids which contain even 24 per cent of silica entirely disguised. When ulmic acid is treated by ammonia, azhumic acid is formed; this contains nitrogen so fixedly, that it is only eliminated at a temperature of about 1200°. This acid is possessed of the remarkable property of readily dissolving silica and combining therewith, in the same manner as the compound alluded to above by Dr. Friedel. The author also states that, although his researches on this subject are not yet quite concluded, he is justified in stating that all arable and garden soil, and, far more so, farm-yard manure, contain similar organic siliceous compounds, which play an important part in the feeding of the plants.

Phospho-Platinic Compounds.—P. Schützenberger.—Mainly a collection of lengthy formulæ.

Existence of Organic Remains in Rocks supposed to be of Igneous Origin.—C. Montagna.—The author replies to the critical remarks made by several German and Russian geologists on his theory of the formation of the so-called igneous rocks, about which he published some papers a couple of years ago. He says that the fossils discovered by him, and deposited in his collection at Naples, are not microscopic objects, but so large as to attract even the attention of the wayfaring people who happen to pass by the spot (near Naples) where they are found.

Electric Condensation.—M. Neyreneuf.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 4, 1870.

The only paper relating to the physico-chemical sciences in this number is—

Superficial Viscosity of Thin Sheets of Saponine Solution.—C. Van der Mensbrugghe.—The author describes, and illustrates by a cut, an experiment wherein the electrical repulsion aids the superficial viscosity of a solution of saponine to keep an open space between the thin sheet of that substance, notwithstanding the tendency of the capillary action to close that opening.

Annales de Chimie et de Physique, May, 1870.

This number contains the following original memoirs and papers:—

On Collision.—A. Dupré.—A very exhaustive and lengthy mechanico-mathematical paper.

Researches on the Gaseous Products of the Combustion of Coal.—A. Scheurer-Kestner.—We regret that, owing to the absolute necessity of the woodcuts added to this paper for understanding its contents, we cannot enter into details on this scientifically as well as practically-interesting subject. The author's experiments confirm those made, now many years since, at Elswick (near Newcastle-on-Tyne), by Sir William Armstrong, Mr. J. A. Longridge, and the late Dr. T. Richardson, as far as regards the combustion of fuel without smoke also having the effect of eliminating from the chimney-gases those which are combustible.

Influence Exercised by Magnetism on Electric Jets Propagated in Partially-Vacuous Space.—A. De la Rive.

Polytechnisches Journal von Dingler, second number for May, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Changes Coal undergoes by Exposure to Air.—Dr. T. Richters.—The concluding part of this very lengthy paper; this portion treats on the so-called weathering of coals. The author has added to this excellent paper a review in tabulated shape, containing the results of analysis (quantitative estimation of carbon, hydrogen, oxygen, nitrogen, ash, coke, heating effect, and specific gravity) of various kinds of coals freshly taken from the pit, and after variable periods of exposure to air.

Lime and Cement.—W. Wolters. This paper treats mainly on the causes of the so-called binding and hardening of what is generally known as mortar, viz., the mixture of sand, water, and slaked-lime; the paper is divided into the following sections:—Slaking of lime; the binding; behaviour towards carbonic acid; gypsum (plaster of Paris); and sulphate of potassa.

Tin which has been Exposed to a Great Degree of Cold at St. Petersburg.—P. Lewald.—The author referring to the phenomenon first observed by Dr. Fritzsche, says, it is not at all a correct statement that the blocks of tin exposed to a cold of − 35° should alter their state of aggregation from that cause; the real cause is that the blocks of tin, usually of 250 cubic inches capacity, are cast in iron moulds and, as a consequence thereof, the metal (tin) contracts unequally and so as to leave in the inside of the blocks cavities often so large as to occupy 40 cubic inches; these hollows are lined by a crystallised metal at a high degree of tension. The tin at St. Petersburg was laying heaped block upon block, and the effect of the cold was simply a remote cause to what took place, the weight of the blocks of metal placed on each other being such as to produce necessarily a pressure too great to be borne by the undermost blocks. The author says, if tin is molten and allowed to cool, so as to shrink uniformly, no cold, even of 40° or less, will have the effect observed in the locality alluded to.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, April, 1870.

This number contains the following original papers:—

Mineral Springs met with in the Neighbourhood of Chur (Switzerland).—Dr. A. Husemann.—Some parts of the Helvetian Republic, and especially the Canton des Grisons, abound with valuable mineral-water springs. The springs of Passug, discovered in 1863

the water of the most prominent of these springs was analysed by Dr. A. von Planta-Reichenau. The locality where these springs are found is about 830 metres above sea level. The result of the analysis of the most important of the springs (Ulricus spring) is—Temperature of water, 8·1 (the temperature of the air being 4·4 at the time of observation); sp. gr., 1·007. 1000 parts of the water contain—Chloride of sodium, 0·8493; iodide of sodium, 0·0008; sulphate of potassa, 0·1568; sulphate of soda, 0·0862; carbonate of soda, 3·7879; carbonate of lime, 0·7126; carbonate of magnesia, 0·3786; carbonate of protoxide of iron, 0·0102; phosphate of alumina, 0·0074; silica, 0·0190; traces of manganese, lithia, and strontia; free carbonic acid, 1·8982. The Theophilus spring, saline chalybeate, contains, in 1000 parts—Solid and gaseous matter, 5·9524. The Fortunatus spring, a saline water very akin to that of the Ulricus spring, contains, in 1000 parts—Fixed and gaseous matter, 8·5391. The author describes further, at length, the Belvedra springs and the Gastiel springs; the water of the former is salino-chalybeate; that of the latter, alkalino-chalybeate, and its composition very closely resembles the well-known Selters water from Nieder-Selters in the Province of Nassau (Prussia).

Purification of the Hydrate of Chloral.—F. A. Flückiger.—The main gist of this paper is that, for medicinal use, the re-crystallised hydrate of chloral alone is suited, while the author recommends, as the best solvent from which to obtain the hydrate in crystalline state, purified sulphide of carbon, the last traces of which are removed from the crystals by a moderately-strong current of cold air.

Experiments on the Production of Sulphuric Acid from Gypsum.—H. Reinsch.—A quintal (hundredweight) of gypsum, CaO,SO_2HO, contains about 57 lbs. of sulphuric acid (so-called English). The author, after referring to the very many hitherto unsuccessful attempts made to obtain this acid from this most abundantly-found mineral, states that, when he mixed 2 parts of pulverised gypsum with 1 part of carbonate of ammonia, and poured water over this mixture, complete decomposition of the gypsum ensues, sulphate of ammonia is formed, and carbonate of lime. The sulphate of ammonia is, in its turn, decomposed by means of common salt, the result being the formation of sulphate of soda and chloride of ammonium, which can again be converted into carbonate of ammonia by means of chalk.

New Researches on Calisay Bark from Java.—J. B. C. Moens.—The author communicates the results of his researches of ten species of *Calisaya dubia*, and two of *Calisaya vera*. The freshly-cut bark contains 64 per cent of water, and when air-dried about 13 per cent. The quantity per cent of all alkaloids together in the ten first-named species varies from 2·465 to 6·010. The quinine varies in quantity from 0·589 to 2·831 per cent. The cinchonidine (not met with in all the barks) is present in quantities from 0·539 to 2·41; the quantity of cinchonine varies from 1·405 to 3·909 per cent. The barks of *Calisaya vera* contained, respectively, 7·442 and 7·482 per cent of alkaloids; the quinine amounted to 3·670 per cent, and the cinchonine to 2·812 per cent. The barks alluded to contain, on an average, after having been dried at 125°, 2·332 per cent of ash, of which 0·728 per cent is lime.

Zeitschrift für Chemie von Beilstein, No. 10, 1870.

The number opens with—

Die Königlich Rheinisch-Westphälische Polytechnische Schule zu Aachen (that is to say—A Full Programme of the Royal Rhenish-Westphalian Polytechnic School at Aix-la-Chapelle).—This establishment, to be opened on the 10th of October next is, says the programme, intended to be a technical high school of the same kind as the Polytechnic School at Hanover, the Architectural Academy and Technical School at Berlin, and a combination of the Ecole Polytechnique, Ecole des Mines, and Ecole Centrale des Arts et des Manufactures at Paris. The main subjects of ordinary instruction are fifty-eight in number, and, beside this, lectures on thirteen extraordinary subjects will be given; in fact, as might be expected from the Prussian Government, the establishment is in every respect complete. The building is an imposing and beautiful one, of large dimensions, fitted up with all the requisites for this purpose. It has been erected in a city, the best which could be selected in Rhenish Prussia, since it is readily accessible, and its situation is healthy; and, what is of more importance, it is eminently the centre of a large manufacturing, mining, and, technically, highly-developed district, and at an easy distance as well from the Rhine as from Belgium and France. The fees for students are exceedingly moderate, and the appointed teachers are men of experience, as well as high scientific standing. French is freely spoken among the middle and upper classes of the city alluded to, which is too well known for its beautiful environs to need further comment.

The following original papers are found in this number:—

Thihydrobenzoic and Dithiobenzoic Acid.—H. Hübner and J. Upmann.—The authors state that their object is to relate the results of their labours on thihydro acids in general, and the substances named at the heading more especially. They first enter into a lengthy discussion, which turns upon the correctness or incorrectness of the labours of Drs. Carius, Vogt, Engelhardt, and others on this subject, and next state, at great length, the preparation of chloro-salicylic acid, with the view of obtaining, from that body, thihydrobenzoic acid; but, since this did not lead to any good result, the thihydrobenzoic acid was prepared by placing dry benzoic acid in the receiver attached to a retort wherein fuming sulphuric acid was heated. The vapours given off converted the benzoic acid into a tough, pasty, brown-coloured fluid, which was first heated by itself, and next treated with carbonate of lead, yielding a salt, $C_6H_4SO_2.O.CO.OPb$. This was converted into a soda-salt, which, in its turn, was acted upon by chloride of phosphorus, yielding $C_6H_4SO_2.ClCO.Cl$, sulphobenzoic acid-chloride, a fluid insoluble in water. This body, treated with tin and hydrochloric acid, yields, after purifying, $C_6H_4.SH.COOH$, thihydrobenzoic acid, very difficultly soluble in water, and not even readily in alcohol; it is a solid crystalline substance, fusing at from 242°—244°. The authors describe several of the salts of this acid, and also metabromo-thihydrobenzoic acid, $C_6H_3Br.SH.COOH$, fusing at 256°, insoluble in water, and readily soluble in alcohol.

Contribution to Our Knowledge of Zirconium.—Dr. E. Melliss.—The author describes—Bromide of zirconium, a white crystalline powder, readily volatilised by heat, decomposes in contact with water, forming zirconium oxybromide, $ZrBr_4+H_2O=2HBr+ZrBr_2O$. The oxychloride of zirconium is $ZrCl_2O.4\frac{1}{2}H_2O$. Zirconium and iodine do not combine together at all. Zirconium and aluminium-silicium, Zr_3Al_6Si, was obtained by fusing together 1 part of zirconium, 5 parts of cryolite, 1 part of aluminium, and 10 parts of a mixture of the chlorides of sodium and potassium.

Final Result of the Action of Chlorine Gas upon Chloronaphthaline.—A. Faust.—The author simply says that the body which has been called β tetrachloro-naphthaline has been found to be enneachloro-dinaphthaline, $C_{20}H_7Cl_2$.

Ortho-Nitrotoluol.—F. Beilstein and A. Kuhlberg.—The authors describe—The sulpho-acid of ortho-nitrotoluol and several of its salts; next, ortho-amido-toluolsulpho acid—

$$C_6H_3(NH_2)O\begin{cases}CH_3\\SO_2H\end{cases}$$

γ dinitrotoluol; γ trinitrotoluol; dinitrotoluol sulpho-acid. The paper winds up with a synoptical tabulated review of para-, ortho-, and meta-nitrotoluol and its derivatives.

Action of Bromine upon Pyro-Tartaric Acid.—B. Lagermarck.—This paper is divided into the following sections:—Monobrom-citraconic acid-anhydride, $C_5H_3BrO_3$, and salts of this acid; tribrom-pyrotartaric acid, $C_5H_3Br_3O_4$, and salts of this acid.

Incandescence Phenomenon of Ammonio-Phosphate of Magnesia and Pyro-Phosphate of Magnesia.—O. Popp.—After discussing, at some length, the value of the assertions made in respect of the cause of this well-known phenomenon, the author states that a series of experiments made by him with perfectly pure materials (because, if the ammonio-phosphate of magnesia is not pure—if even a trace of lime or other salts are present, the phenomenon is either not seen at all, or greatly decreased), has proved to him that the cause is due to a change, or conversion, from the crystalline to the amorphous state; a kind of fusion takes place. The corresponding arsenic combination does not exhibit the incandescence, because it is decomposed, on being heated, in a more complex manner, the result of which is the setting-free of some magnesia. The oxides of iron and chromium, when heated as hydrates, also exhibit incandescence; and the author states that the great difficulty experienced in re-dissolving these oxides after ignition in strong acids, is due to the partial fusion they undergo at the moment the incandescence takes place.

Bayerisches Industrie und Gewerbe Blatt, April, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences.

Woody Fibre as a Substitute for Paper-Making Materials, and on Völter's Wood-Shaving and Pulping Machine.—Dr. Landes.

The Manufacture of Paper in General, and on the Quality of the Paper made Now-a-days as compared with that made at More Remote Periods.—J. Bullinger.—These two memoirs are, we we regret, too lengthy for any useful abstraction, but contain very valuable hints to paper makers.

Preparation of Spirits from Lichens.—Dr. Stahlschmidt.—The large quantities of lichens (marine as well as terrestrial) found in many parts of Europe may be, indeed, usefully applied in this manner, and thus a saving effected in the consumption of grain for the purposes of distilleries. The author describes the process at length; the cellulose of the lichens or moss is converted into glucose by boiling with from 7 to 10 per cent of the weight of the mass of hydrochloric acid (sp. gr. 1·165) by the aid of steam; the acid is saturated with chalk, and the saccharine matter brought to fermentation; 20 lbs. of moss or lichen yield five litres of spirit at 50 per cent anhydrous alcohol.

The Journal of the Franklin Institute, April, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and applied sciences:—

Carbonic Acid Apparatus.—W. H. W.—The description, illustrated with a woodcut, of an improved apparatus for the estimation of carbonic acid upon the plan of Mohr's well-known contrivance. The use of anhydrous sulphate of copper, jointly with fused chloride of calcium, is recommended as a drier in case hydrochloric acid is used in the analysis.

Corrosion of Iron Water-Pipes.—M. Graff.—The pipes alluded to, made of wrought-iron (boiler-plate), 7 feet in diameter, were completely preserved against corrosion by being painted, while hot, with boiled coal-tar; an attempt to protect the pipes by strips of zinc entirely failed. Nothing is said as regards the cause of the corrosion, but the pipes are used to convey water for drinking and domestic purposes.

Physical Constitution of the Sun.—B. A. Gould.—A lengthy paper discussing various points of scientific interest in relation to this subject.

Diffraction Produced by the Edges of the Moon.—E. C. Pickering.

Coal and Smoke Consumption.—J. T. Rich.—The author describes a contrivance whereby the bituminous coal, used as fuel for locomotive engines on the Pennsylvania railroad, is gradually converted, while serving as fuel, into coke, the combustible gases and volatile matter giving off flame, and the result being a very complete combustion free from smoke; but the question whether steam can be made fast enough is not yet decided.

Journal für Praktische Chemie (double number), Nos. 8 and 9, 1870.

The greater part of this number is filled with Professor von Liebig's paper—

Fermentation and the Source of Muscular Power.

The following original memoirs and papers are also met with in the above-named journal:—

Fluorbenzoic Acid and Fluorbenzol.—Dr. R. Schmitt and Dr. H. von Gehren.—The authors describe at great length the preparation of fluorbenzoic acid from diazo-amido benzoic acid, by treating that substance at a high temperature in a platinum basin with hydrofluoric acid; the reaction takes place according to the following formula:—

$$C_{14}H_{11}N_3O_4+2HFl=C_7H_5FlO_2+C_7H_7NO_3,HFl+2N;$$

the fluorbenzoic acid thus obtained resembles, as far as its physical properties are concerned, benzoic acid; it is, however, far more volatile, fuses at 182°, difficultly soluble in cold, readily in hot, water, as also in ether and alcohol; its aqueous solution exhibits a strongly acid reaction to test paper and decomposes inorganic carbonates very readily; the acid does not act upon glass, is a very fixed substance, which may be even dissolved in concentrated sulphuric acid without decomposition; formula—$C_7H_5FlO_2$; contains 13·6 per cent of fluorine. The authors describe a series of the salts of this acid; the formula of the silver salt is—

$$C_6\left\{\begin{matrix}H_4\\Fl\end{matrix}\right\}CO,OAg;$$

calcium salt—

$$2\left[C_6\left\{\begin{matrix}H_4\\Fl\end{matrix}\right\}CO,OCa\right]+3aq.;$$

fluorbenzol, C_6H_5Fl, is a crystalline solid, boiling at about 183°, fusing at 40°, insoluble in water, and specifically heavier than that liquid, readily soluble in ether and alcohol.

Action of Fluid Phosgen on Some Organic Compounds.—Dr. Th. Kempf.—This lengthy memoir is divided into the following sections:—Action of fluid phosgen upon phenol; action of fluid phosgen upon cresol; action of fluid phosgen upon thymol; action of fluid phosgen upon benzoyl hydride; action of fluid phosgen upon aceton.

Formation of Ozone during Active Combustion.—C. Thau.—The author describes, at length, a series of experiments which prove that during the rapid combustion of substances containing hydrogen, especially gases, a certain though small quantity of ozone is formed; the conditions under which the substance is best obtained during combustion are also fully explained.

Behaviour of Permanganate of Potassa with Sulphuric Acid.—Dr. Spiess.—The author states that while he was engaged preparing from a mixture of permanganate of potassa (the dry salt) and concentrated sulphuric acid ozone, he was astonished by the appearance of violet-coloured vapours, which at first he believed to be due to iodine, and consequently an impurity of the salt alluded to; on investigation, however, no iodine was found at all; on repeating the experiment, the author obtained what he thinks is a new, hitherto unknown, compound, but his researches on this point are not quite finished.*

On Rabdionite, a New Mineral, and on Asbolan.—F. von Kobell.—The mineral called rabdionite by the author has a specific gravity of 2·8, is black coloured, while in solid lumps its powder is deep brown; it fuses readily before the blow-pipe, yields, with borax, a blue-coloured bead, is completely dissolved by hydrochloric acid, chlorine being evolved; in 100 parts it consists of peroxide of iron, 45·00; oxide of manganese, 13·01; alumina, 1·4; oxide of copper, 14·0; protoxide of manganese, 7·61; protoxide of cobalt, 5·10; water, 13·5; formula—

$$\left.\begin{matrix}CuO\\MnO\\CoO\end{matrix}\right\}FeO_2 \qquad +2HO;$$
$$MnO_2$$

the asbolan alluded to by the author is a mineral found near Saalfeld; it contains a small quantity of lithia, but chiefly oxide of manganese, which constitutes 54 per cent of the whole.

The Theory of Flame.—K. Knapp.

The Polybromides of the Tetra-Ammonium Bases.—P. C. Marquart.—The first instalment of a lengthy memoir on this subject.

* The editor of this periodical, in a foot note, states that the material alluded to by the author of this paper is permanganic acid contaminated with some sulphuric acid, and also calls attention to the researches on the action of the two substances alluded to, made by Dr. Unverdorben, Dr. Wöhler, and others.

Les Mondes, June 16, 1870.

This number contains, under the title to be presently mentioned, a statement which, although strictly of architectural importance only, we mention because it concerns one of the largest, as well as one of the most celebrated, buildings of the world—

Inclination of the Axis of the Basilica of St. Peter at Rome.—In a letter to the eminent editor of the above-named periodical, it is stated that M. Crozes, a barrister from Albi (France), while temporarily sojourning at Rome, and minutely inspecting the celebrated Basilica (church), found that the main lines (centres) of the dome and the western main entrance of the building, do not, as it should be, coincide, but are no less than 1·5 metres mutually out of the plumb-line. (The building was not constructed by one architect—the dome being the work of Michel-Angelo, and the rest that of Carlo-Maderno.) This defect, it appears, has never even been found out, even in modern days; and, on being consulted on the subject, was found to be unknown as well to the Rev. Father Secchi, S.J., as to Chevalier Martinuci, Professor Sarti, Count Vespignani, and other scientific and architectural authorities at Rome, who, however unwilling to believe, cannot deny the fact as ascertained, and as stated above, to have been accidentally discovered by a non-professional, but an unprejudiced observer. The matter, as may be readily imagined, is now to be thoroughly investigated; but the writer of the letter above alluded to states that the main fact, as discovered, remains, as yet, undisputed.

June 23, 1870.

Osmose.—Under this heading, the excellent editor of this periodical states that he has received intelligence from the large beet-root sugar manufactory at Arlowetz, Southern Russia, stating that the osmose process has been applied there under peculiarly-favourable conditions, whereby, on the large scale, 25 per cent of sugar has been obtained from the third crystallisation, instead of only 8 per cent as when the usual methods are applied.

The Arènes of Paris.—M. de la Follye.—This author addresses, to the editor of *Les Mondes*, a very lengthy letter, from the contents of which it appears that this building is not at all of Roman construction, but is the work of the King Chilperic (Merovingian race), whose contemporary, St. Gregory of Tours, states, in papers of undoubted authenticity, that this king built arènes at Soisson and Paris. The author, moreover, observes that this statement is fully confirmed by the mode of architecture and materials used, as quite distinct from anything of the kind done by the Romans. The age of the building is, therefore, only thirteen, instead of nineteen or twenty centuries.

NOTES AND QUERIES.

Ozone.—Can any of your readers give me the most expeditious and economic way to produce ozone in quantity?

Atomic Weights.—If $Co_6NO_3+6(KNO_3)=C_2O_3=18·35$, $K_2O=31·24$, and $N_2O_3=50·41$ per cent, what are the atomic weights of Co, K, N, and O? An answer will greatly oblige.—A Student and Constant Reader.

Estimating Sulphide and Sulphite of Calcium.—Can any of your correspondents kindly inform me of a method of estimating the sulphite and sulphide of lime in black-ash waste after being oxidised by Mond's process?—Alkali.

Lead Roofing.—(Reply to "Slates")—The matter you complain of is not of rare occurrence, and its prevention is not an easy matter, since lead which has even been painted over is gradually acted upon in the manner alluded to. As a remedy, you may try good asphalt-varnish, used as a paint, or thickly-boiled coal-tar, applied on the metal while hot. But the best of all will be to convert the lead superficially into sulphide (black-coloured) of lead, by washing the lead over with a hot and concentrated solution of a soluble alkaline sulphide; for which purpose the substance known under the name of "hepar sulphuris," of the older pharmacopœias, will answer very well. Galena, crystallised sulphide of lead, is not perceptibly acted upon by atmospheric agency; and the amorphous sulphide of lead is insoluble in water, even when containing carbonic acid.

TO CORRESPONDENTS.

*** Vol. XXI. of The Chemical News, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

J. Muspratt and Sons.—Received with thanks.

S. Beswick (Paterson, New Jersey).—Many thanks for your communications; they shall be inserted in an early number.

One of your Subscribers.—A description of "The Ozoniseur," is not given in M. Houzeau's memoir.

F. W. Clarke (San Francisco).—Any light tar oil will serve as fuel for Griffin's oil blast lamp; the price would be £2 10s. Our publisher would undertake the forwarding of any apparatus you may require.

THE CHEMICAL NEWS.

VOL. XXII. No. 555.

PRELIMINARY NOTE ON A

NEWLY-DISCOVERED PROPERTY BELONGING TO RUBIDIUM AND CÆSIUM,

AND ON THEIR OCCURRENCE IN SEA-WATER AND IN MARINE PRODUCTS.

By E. SONSTADT.

WHEN chloride of calcium and oxalate of ammonium are added in sufficient quantity to a neutral or alkaline solution containing rubidium and cæsium, the whole of these alkalies falls with the precipitated oxalate of calcium, from which they cannot be washed out. Other alkalies, if present, remain in the solution. Rubidium and cæsium are thrown down in like manner along with carbonate of calcium, but the precipitate is slightly decomposed by prolonged washing with pure water; nevertheless, the filtrate, with a moderate quantity of washings, is spectroscopically free from these alkalies. With sulphate of calcium, the behaviour is similar, but the compound formed is more soluble than from the calcium-salt; and from a large quantity of sulphate of calcium, containing but little of these alkalies, most of the latter may be separated by much washing. Rubidium and cæsium fall, also, with tungstate of calcium, but the compound is almost entirely decomposed by much washing. When a solution of chloride of calcium containing rubidium and cæsium is *partially* precipitated by oxalate of ammonium or carbonate of sodium, a portion of the rare alkalies remains in solution with the remainder of the calcium-salt. A strong solution of chloride of calcium, whether in water or in alcohol, dissolves the chloro-platinates of rubidium and cæsium rather freely, and the latter are not precipitated on dilution. Neither carbonate of magnesium nor alumina carry down with them rubidium and cæsium salts.

Sea-Water.—If oxalate of ammonium is added in excess to sea-water, and the well-washed precipitate ignited, moistened with nitric acid, and examined in the spectroscope, the Rb and Cs α lines will be distinctly seen in a good flame of dry hydrogen. Whether they would also be visible if examined in the usual gas-flame of a Bunsen's burner, I have no opportunity of trying. One ounce of sea-water gives material enough for several trials in the spectroscope. When, however, sea-water is evaporated to dryness, and the residue treated with a small quantity of water, filtered, the filtrate evaporated to a very small bulk, and, after addition of nitric acid, examined in the spectroscope, only the sodium and potassium lines are visible, nor can the rare alkalies be detected in the filtrate by the help of precipitation by platinic chloride.

Seaweed.—I became aware of the presence of other than the common alkalies in seaweed more than eighteen months ago. Rubidium and cæsium may be detected by the careful application of ordinary methods, not only in mother liquors, but in "kelp salts," in sulphates and chlorides of potassium, and in the drainage of wet seaweed.

Shells.—A few shells from the sea-shore have been examined by igniting chips, moistening with nitric acid, and introducing to the hydrogen-flame before the spectroscope. All gave the Rb and Cs lines apparently with equal intensity and with one another, and with lime obtained direct from sea-water. Among the shells examined, were those of the oyster and acorn-barnacle.

Limestone.—Lime from Castletown, in the Isle of Man, showed in spectroscope exactly like the shells above-named. About a pound-weight of this lime was put into a funnel, and slowly washed for about ten days; it still showed the Rb and Cs lines, but the latter very faintly. The filtrate was evaporated to a small bulk, air being blown through until a scum no longer formed. The liquid portion was then rich in potassium salts but did not contain a spectroscopic trace of Rb or of Cs. Every trace of these alkalies that had been washed out of the lime remained with the carbonate of calcium formed during the boiling down. The lime brought to Ramsey, from Castletown, contains many lumps which scarcely "slake" on wetting; such lumps are locally called over-burnt, but a qualitative examination showed that they differed from good lime only in containing a larger proportion of clay. As the clay in ordinary limestone is usually supposed to be the source of the alkalies, it might have been expected that this clayey lime would have been richer in rubidium and in cæsium than the other sort. But the contrary was the case. *Marl*, from near Ramsey, which contained much carbonate of calcium, with clay, shows no line of Rb and Cs when examined in the spectroscope in the same manner as the other substances mentioned. The average of such Castletown lime as I have examined contains about 5 per cent of clay, equal to about half that proportion in the limestone before burning.

I have made some approximate quantitative determinations of the proportion of rubidium and of cæsium contained in some of the substances mentioned in this note; but, as these results are, as yet, only roughly approximate and incomplete, I reserve them, as well as all theoretical considerations, for another time. But, this much is already clear—these alkalies can no longer be styled rare, since even in a few grammes of sea-water they can be easily recognised.

GENERAL DOCTRINE OF SOLUTIONS. SWEDENBORG IN 1721-2 AND DALTON IN 1840.

By S. BESWICK.

THE practical scientist will contend that we must reserve the honours of science and discovery for those who reduce conjecture to truth by the evidence of experiment. This rule is well recognised and established, and we accept it as founded in justice and necessity. The first experimental demonstrator of the general doctrine of solutions, and he only, shall have the honours. Practical Science has no religious prejudices, and acknowledges no favourites. If Swedenborg lays down clearly the general doctrine of solutions, and gives definite experimental illustrations of the doctrine, then, we claim, he has fulfilled the conditions, and reduced conjecture to truth by the evidence of experiment and observation; and we expect that critics of the experimental school will give him the honours promised to be reserved for only such as he has proved to be.

The general doctrine of solutions approximates in importance to that of the atomic theory. Dalton appears to have been the first to make this important discovery amongst the chemists of this century. He first observed it about the year 1840, at which time he pronounces it a new discovery. But Swedenborg had published the same doctrine, with abundant illustrations, so far back as 1721-2. His statements are clear, full, and well founded. The following paragraphs are a few which we have taken from his "Principles of Chemistry":—

"When the particles of water contained in the salt are added to the particles of the fresh water, the number of the latter is increased by the number of those in the salt, *that is, they increase the bulk by their own bulk; but it is not so with the saline particles, which only occupy the space in the interstices*, according to the demonstrations in the preceding theories.

"*The saline particle in water does not increase the space, but only occupies the void*; so that, whatever quantity of salt there may be in the water, *the volume is*

not in the least increased by the mere particle of salt; but *the weight is augmented.* Whatever increase of bulk there may be is derived from the particles of water contained in the mass of salt, as will be mentioned hereafter. Hence the saline particle, according to our theoretical delineation, possesses the following qualities:—It can flow easily in water; it fits the convexity of the watery particles; it constitutes one volume with them; it may be separated from them by the slightest touch or motion; it is constantly attended by six aqueous globules, whether it move upwards or downwards; and, by this connection, there is *no increase* whatever *in the volume* of the water, but *only in the weight.*—(P. 31).

"We have now to take into consideration the increase of the solution in bulk and weight. For it is well known that salt water is heavier than fresh; so that the degree of saltness may be determined by the weight. And this fact, likewise, indicates that the saline particles do not require any separate place for themselves, but that they are contained in the interstices between the particles of water. We have shown that the mere particles of salt *cannot at all add to the bulk, but only to the weight,* because they occupy the spaces between the aqueous particles."

These theoretical statements are clear and explicit; indeed, it would be difficult to express an idea in more definite and positive terms than those which Swedenborg has used in the above passages. I am not aware that any conjectures of this important fact were ever published until it was actually discovered by Dr. Dalton, in the year 1840, about 119 years after Swedenborg had published it in his "Principles of Chemistry." In the year 1840, Dalton discovered that dry salts have *no volume* in solution up to the point of saturation. He read an essay to the Manchester Literary Society, October 6th, 1840, on the "Quantity of Acids, Bases, and Water in Salts," from which we cite the following passages:—

"I was greatly surprised at the results. If the salt was *anhydrous*, it would all go into the bottle, exactly filling it to the grain, showing that the salt enters into the *pores* of the water.

"The water and solid matter are the *same in bulk* as the water itself. The *solid* matter would go into the *pores* of the water.

"The *solid matter* only adds to the *weight*.

"I have tried the carbonates, sulphates, nitrates, muriates or chlorides, phosphates, arseniates, oxalates, citrates, tartrates, acetates, &c.; and have been universally successful. Only the water adds to the *bulk*, and the *solid matter* adds to the *weight*.

"Suppose I take water of 1000 grains' weight, and the sulphate of magnesia and water of 1112 grains' weight: they will be of the same *bulk*."

And, in a paper read at a subsequent date, to the same society (*Manchester Memoirs*, vol. i., new series), he expressly declares that this fact was *new* to him, and to the scientific world at that date (1840); the discovery of which almost rivalled that of the atomic theory. He says:—

"*This fact was new to me, and, I suppose, to others. It is the greatest discovery that I know of, next to the atomic theory.*"

In nearly all these passages, the words are italicised by Dalton himself. The principal, if not the only, reason for writing the first essay was to publish to the world what he regarded as a new and important discovery—that acids, bases, and salts do not add to the bulk, but only to the weight, of solutions. The question of priority of publication can be readily seen from the following comparison of dates and statements.

Swedenborg in 1721-2.

"We have shown that the mere particles of salt cannot at all *add* to the *bulk*, but only to the *weight*, because they occupy the spaces between the aqueous particles."—(P. 51).

Dalton in 1840.

"The water and solid matter are the same in *bulk* as the water itself. The solid matter only adds to the weight. The solid matter would go into the pores of the water."

The same fact is as broadly announced by Swedenborg as by Dalton, and in terms whose identity with those used by Dalton cannot be disputed. Indeed, the fact is more tersely and clearly expressed by Swedenborg than by Dalton.

Drs. Playfair and Joule have pursued similar researches, supplemental, in point of time, to those of Dalton; and have come to conclusions coinciding with results first obtained by the author of the atomic theory. Acids, bases, salts, add nothing to the volume or bulk of solutions, but only to their weight. Other chemists have obtained like results. It was thought that Dalton's experiments and alleged discovery required the verification of additional testimony and experiments before such a remarkable law was acknowledged; and these latter researches were designed to give this verification.

We claim that the Swedish philosopher, Swedenborg, was the first to suggest, verify, publish, and place on record, in a work called "Principles of Chemistry," the date of whose publication is certain, the general doctrine of solutions. The right to a scientific idea or theoretical discovery is secured by the act of publication; and, in virtue of such act, priority of conception and verification of the general doctrine belongs indisputably to Swedenborg.

Paterson, New Jersey, U.S.,
June 15th, 1870.

ON THE

POTASSIO-COBALTIC NITRITE KNOWN AS FISCHER'S SALT, AND SOME ANALOGOUS AND RELATED COMPOUNDS.

By SAMUEL P. SADTLER.

(Concluded from p. 17.)

HAVING now made a complete statement of all my analytical results in the case of Fischer's salt proper, as well as in this series of analogous and related compounds, which I have described in this connection, and noticed the conclusions to be drawn from them, before summing up my argument I will examine how the results of Stromeyer, Erdmann, and Braun compare with my own. In the first case, I think the last argument drawn from the similarity of weights of double nitrite and double sulphate in the protoxide-salts, and the difference of weights of double nitrite and double sulphate in the sesquioxide-salts, effectually precludes our assigning a formula like that of Stromeyer (in which $2(N_2O_3)$ combines with Co_2O_3) to the normal Fischer's salt. The salt Stromeyer analysed was probably a mixture of "acid" and "neutral" salts, as he speaks of adding "a little acetic acid." It is easily seen that a mixture of the "acid salt" and the yellow "neutral salt" would give figures approximating to his. Erdmann's results correspond, in the main, to the analysis of my second preparation. The only difference, then, is that I have introduced a generalisation, which, I think, my figures fully justify. With Braun's results I am hardly able to make a comparison, as he made his preparation in a manner totally different from that followed by either Erdmann or myself. His formulæ, as might be inferred from my statement of them in the beginning of this paper, I am still less able to accept.

To sum up briefly, the reasons for regarding Fischer's salt as a potassio-cobaltic nitrite, having the essential formula $Co_26NO_2 + 6(KNO) + aq.$, are:—

1. The liberation of O at the moment of its formation,

and the rapidity with which, under these circumstances, the salt forms, would seem to justify the assumption.

2. The analyses of six distinct preparations sustain it.

3. The existence of corresponding sodic and ammonic salts is proved by analysis.

4. The formation of substitution-compounds exactly analogous to well-known salts is proved by analysis.

5. The analogy of Fischer's salt to double cyanides, chlorides, and nitrites proved to contain a similar hexatomic atom.

6. The difference of ratio between the weights in the protoxide and sesquioxide salts is marked and constant throughout.

Accepting these proofs, we will sum up with equal brevity the formulæ of the salts analysed on this view—

Tri-potassio-cobaltic nitrite,	$Co_3 6NO_3 + 6(KNO_3) + aq.$
Di-sodio-cobaltic nitrite,	$Co_3 6NO_3 + 4(NaNO_3) + H_2O.$
Tri-sodio-cobaltic nitrite,	$Co_3 6NO_3 + 6(NaNO_3) + H_2O.$
Di-ammonio-cobaltic nitrite,	$Co_3 6NO_3 + 4(NH_4NO_3) + 2H_2O.$
Tri-ammonio-cobaltic nitrite,	$Co_3 6NO_3 + 6(NH_4NO_3) + 2H_2O.$
Luteocobaltio-cobaltic nitrite,	$Co_3 6NO_3 + Co_2 12NH_3, 6NO_3 + H_2O.$
Roseocobaltio-cobaltic nitrite,	$Co_3 6NO_3 + Co_2 10NH_3, 6NO_3 + H_2O.$
Xanthocobaltio-cobaltic nitrite,	
Potassio-dicobaltous nitrite,	$2(Co_2NO_3) + 2(KNO_3) + H_2O.$
Potassio-monocobaltous nitrite,	$Co_2NO_3 + 2(KNO_3) + H_2O.$

These, it will be seen, are capable of ready conversion into atomic formulæ, thus:—$Co_2^{VI}[K(NO_2)_2]_6$ and $Co_2^{VI}[(Na(NO_2)_2)_2(NO_2)_4]$, and so on.

In the course of my examination of these salts, I had an opportunity of comparing the relative merits of the different analytical methods employed. A brief statement in regard to them may be of some value.

1. Determination of Co and K. The double sulphate method, already alluded to, was first proposed by Gibbs and Genth;* and I find it to give extremely close results. Sulphuric acid is added to the weighed portion of the salt, in a porcelain crucible, which is then heated carefully, either by a ring gas-burner from above or by radiation while supported in a sheet-iron crucible. After the nitrous acid is all driven off, with most of the excess of sulphuric acid, the sulphates begin to fuse, and as the last trace of sulphuric acid goes off they pass into calm fusion; they will then bear a very considerable increase of heat without farther decomposition. I found this method capable of extension to both the soda-salts, as well as to the protoxide-salts, the double sulphates formed having, of course, a constitution depending upon the proportion of the bases in the original salts. The soda-sulphates did not appear, however, to possess as perfect a fusibility as the double potash-sulphate from Fischer's salt; while the double sulphates from the protoxide potash-salts were also less fusible, in proportion to their greater ratio of Co. I give an instance in proof of the accuracy of this method. Four determinations of $CoO + K_2O$ were made in Preparation No. 6 of Fischer's salt, in the manner described. The percentages of double oxides were—48·71, 48·69, 48·66, 48·71. This method was tried by Gauhe,† without obtaining good results. Several points are to be noticed, however. The salt in which Gauhe sought to verify the composition of the double sulphate was plainly a mixture of "acid" and "neutral" salt. He says, "After some days, small amounts deposited." This was before Erdmann's paper had appeared. Again, Gauhe will find that Gibbs and Genth never even mentioned the use of $(NH_4)_2CO_3$ in this connection; so that his experiments were plainly made under different conditions from those proposed.

2. Determination of Co. I prefer to determine Co as neutral $CoSO_4$. We have the advantage here of determining the Co in the form of a compound of higher atomic weight, thus lessening our errors of analysis. The cobalt is precipitated from the solution of the double sulphates as CoS, washed with hot sulphide of ammonium water, dried and roasted, and then converted into sulphate with the aid of aqua regia and sulphuric acid. The results are good, although not so exact as in the case of the fusible double sulphates. I also determined Co as metal, by H, after its precipitation as hydrated oxide by Cl and acetate of soda—a method proposed by Popp.* Instead of Cl, I found it far more convenient in practice to use a strong solution of Cl_2O_4, which is a powerful oxidising agent, and, as it can be kept, becomes a useful laboratory reagent. This method, however, does not always give good results, on account of the difficulty of washing the hydrated Co_2O_3 till free from alkali.

3. Determination of the N. This was done first by the modification of Bunsen's‡ method proposed by Dr. W. Gibbs,‡ which space will not permit me to give in detail; the reader is therefore referred to the original paper. Suffice it to say that, for nitrates and nitrites to which it is applicable, it is an excellent method. The loss of the combustion-tube can be nothing but N and H_2O. If, therefore, the $CaCl_2$ tube retains the H_2O accurately, the remainder is N. Whether, therefore, the H_2O is accurate or high from hygroscopic moisture, the nitrogen must be accurate, being subject to no source of error.

The nitrogen was also determined by volume, using the Sprengel pump. This method was first proposed by Frankland‖ for nitrogen in analyses of potable waters, but he did not apply it then to organic analysis. The application, however, had been made in this laboratory, by Dr. Gibbs, some months before Dr. Frankland's paper was received. A vacuum is first made in the combustion-tube, by means of the mercury-pump; the delivery-tube from the pump is then connected with a Simpson's receiver, and the vacuum destroyed by heating some CO_2 placed in the anterior portion of the tube. Any excess of CO_2 is absorbed by the KHO solution in the receiver. The combustion is now made. A final vacuum is then obtained by the pump, and the receiver disconnected. After a short time, the gas is transferred to a eudiometer-tube, and measured according to the methods of gas analysis. The results are generally good, but depend upon the vacuum obtained at the beginning and end, on the perfect combustion, and on the perfect transfer of the gas.

In conclusion, I would present my grateful acknowledgments to Dr. W. Gibbs, to whose kindness I am indebted for the selection of my subject, for the use of materials, and for many valuable suggestions during the prosecution of my work.—*Am. Jour. Sci.*, lxix., 189.

* "Researches on Ammonia-Cobalt Bases," p. 49.
† *Zeitsch. Anal. Ch.*, iv., 56.

* *Ann. Ch. u. Ph.*, 131, 363.
† *Ann. Ch. u. Ph.*, 72, 40.
‡ *Am. Journ. Sci.*, xxxvii., 350.
‖ *Qu. Journ. Chem. Soc.*, 1868, p. 90.

AIR-POLLUTION BY CHEMICAL WORKS.

A MANUFACTURER, having realised his primary object of making what he can out of the materials which pass under his hands, and having utilised all that he deems valuable in them, finds there is yet another need to be fulfilled;—he must get rid of his refuse, and that as speedily as possible. Our present object is to watch this latter operation, and, losing sight of the beautiful or useful results of his work, to direct our attention to what is waste or refuse, and enquire how he disposes of it. When this is solid and bulky, it must be removed at the cost of much labour, and a place must be provided where it can be deposited. When the refuse is a liquid, the process of getting rid of it is generally less expensive; it will flow away in the water-courses, if only proper drains and passages are provided. When the refuse is gaseous, this process of removal is easier still: no passages need be cut, no culverts nor bridges built; the vapour can be allowed to pass into the air, and is blown away.

In each of these cases the manufacturer's object is attained; he is rid of the refuse, and has room for renewed work. Unfortunately, however, although he is rid

Fig. 2.

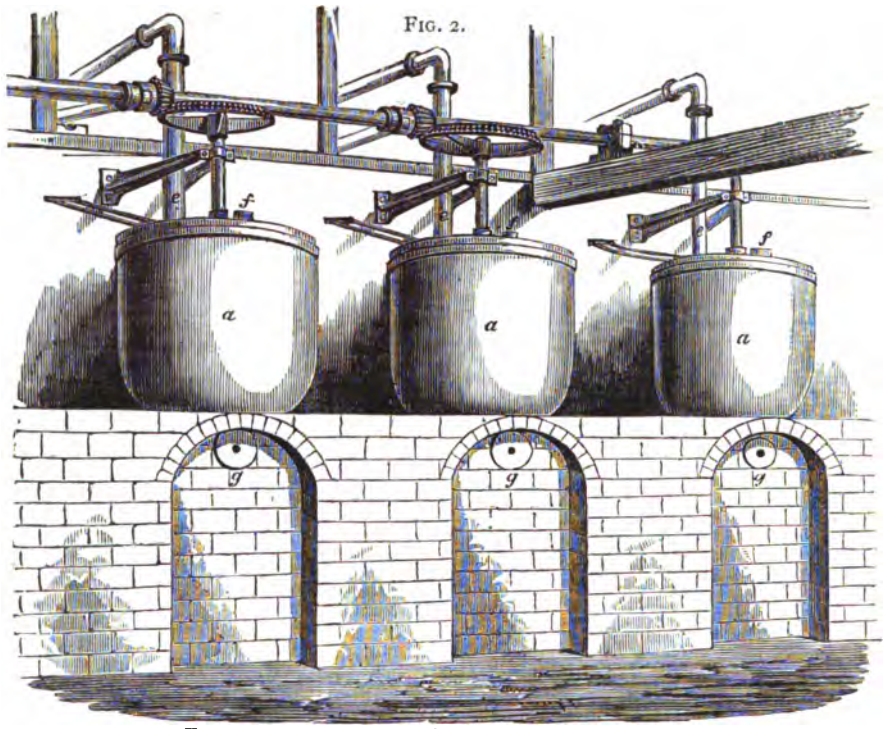
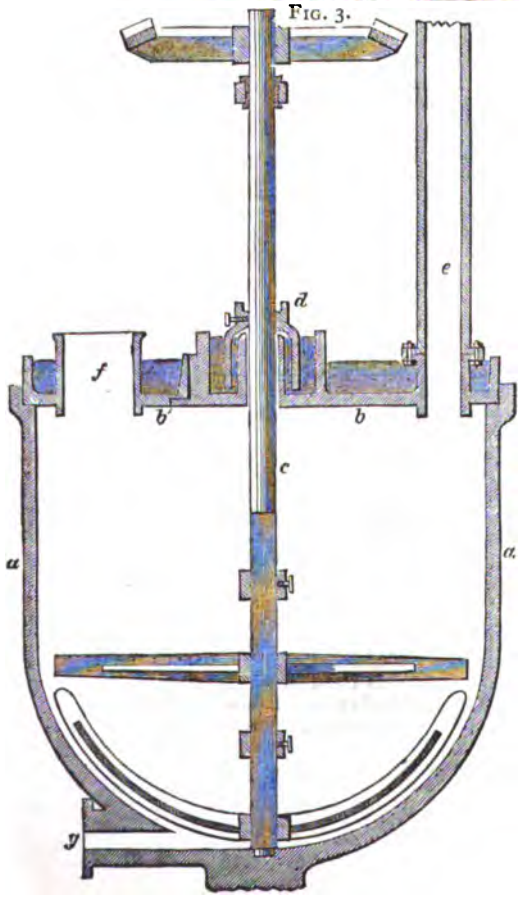


Fig. 3.



rim, and so arranged that cold water may be kept circulating over their surface; this assists in condensing the benzol, which would otherwise distil away by the heat of the reaction. Through the larger half of the cover the spindle of the stirrer, *c*, passes, and on account of the difficulty of keeping a stuffing-box in order when using the powerful chemicals necessary in this manufacture, a kind of water-joint has been substituted. It is necessary that it should be deep and rather capacious, as seen at *d*. Instead of filling this joint with water, which would absorb the nitrous fumes, and produce an acid solution, which would soon destroy the apparatus, the joint is filled with nitrobenzol; a cast-iron tube, *e*, passes through the lid to carry nitrous fumes; this is also cooled, so as to condense any benzol vapour which may have escaped the cooling action of the lid; small pipes are introduced through another opening for the purpose of supplying the necessary chemicals. Besides these there is a large opening, *f*, in the smaller half of the lid, for the purpose of introducing any of the products, which may be added in large quantities at a time. At the bottom of these large vessels are openings for running out the finished product.

The process of preparing nitrobenzol with a mixture of sulphuric acid and nitrate of sodium in place of nitric acid, may be carried on very well in this apparatus, provided sufficient sulphuric acid be employed to produce an acid sulphate of sodium, as this will be found quite fluid at the close of the operation, and can be freely run out at the small outlet. A mixture of strong nitric acid and sulphuric acid is now usually employed for the conversion of benzol into nitrobenzol. In working by this latter method the entire charge of benzol is first introduced through the large opening in the lid; this is then closed and the stirrer set moving; the nitric and sulphuric acids are then cautiously run in through the small pipes, care being taken not to add too much nitric acid, until the red fumes begin to appear. After all the charge of acids has been added, and the reaction has perfectly ceased, the product is drawn off. At first a mixture of sulphuric and nitric acids runs out, and then the nitrobenzol; this is collected separately and purified,

first by agitation with water, and then rendered perfectly neutral by means of a dilute solution of soda. Should it contain any unconverted benzol, this may be distilled off by means of steam. On the Continent, manufacturers do not appear to have succeeded well in manufacturing nitrobenzol; when it first became a commercial article, their difficulty appears to have arisen from the fact that they experimented in earthenware vessels, which are both dangerous and unsuitable, and it was not until information was obtained from England, I believe, that they were able to produce this body at a moderate price.

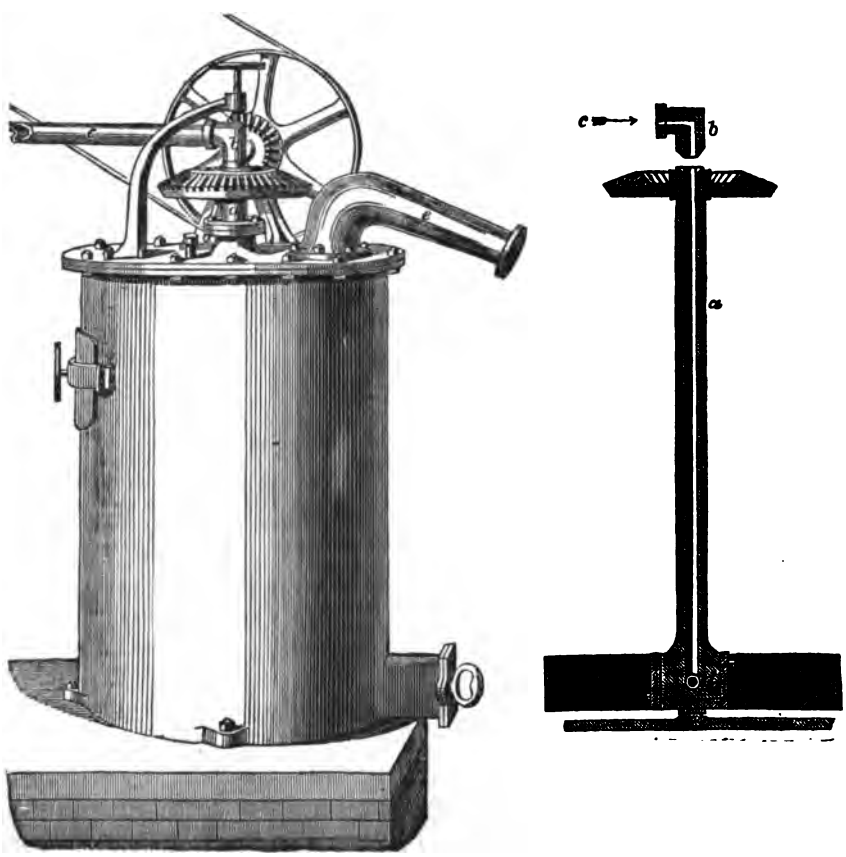
We will now pass on to the processes for converting nitrobenzol into aniline. I have already mentioned that Zinin was the first who discovered that nitrobenzol could be converted into aniline, or, as he termed it, benzidam. His process consisted in treating an alcoholic solution of nitrobenzol with ammonia and sulphuretted hydrogen; but, although the discovery of this process was one of great importance from many points of view, still it was very tedious. Bechamp, however, found that by employing a mixture of acetic acid and finely divided iron instead of ammonia and sulphuretted hydrogen, the nitrobenzol was very rapidly converted into aniline, and this process has been found the best yet proposed for manufacturing aniline in large quantities. Many other reagents have been suggested, as arsenite of sodium, powdered zinc, &c., but none of them have been found so advantageous as iron and acetic acid.

In carrying out Bechamp's process, cylinders like those used for nitrobenzol (Fig. 1) were originally employed. The cylinder was set in brickwork, and heated by means of a small furnace, iron borings were first introduced, and the door fixed in its place air-tight. One neck was connected to the upper extremity of a cast-iron worm by means of a pipe called an adapter; the second neck being fitted with a syphon-tube, for the introduction of the nitrobenzol and acetic acid. In working on the large scale it is necessary to add the nitrobenzol and acetic acid in small quantities at a time, otherwise the reaction is so violent as to almost burst the apparatus: by working carefully, however, there is no need to fear any difficulties, especially if the stirrer is well used. By the time all the charge has been introduced, a quantity of fluid will have distilled over; this is returned into the cylinder and the fire lit, and the aniline distilled off.

The principal change which has taken place in this process consists in using high pressure or superheated steam for the distillation instead of fire, and working the apparatus by means of a steam-engine instead of by hand. In Fig. 4 is shown a sketch of the apparatus now generally employed for the preparation of aniline.

You will observe that the stirrer, which is worked by bevel wheels, has a hollow shaft or spindle, *a*, as seen in the section. This is ground to an elbow, *b*, connected to the steam main, *c*, and held down by a screw, so that when the steam is turned on, it passes through the hollow elbow down the shaft, and then blows out at the bottom, *d*, among the products; and in this manner the aniline is volatilised, and passes with the steam through the neck, *e*, and is condensed by a worm, not shown in this drawing. Aniline thus obtained is generally redistilled, and sometimes with a little lime or caustic soda, for the purpose of decomposing a body called acetanilide, which is often produced in the manufacture of aniline,

FIG. 4.



especially if the operation is conducted over a fire instead of with steam.

Commercial aniline generally appears of a pale sherry colour; when chemically pure, it is colourless, but if kept long it becomes quite brown. It possesses a peculiar odour, which is slightly vinous when the aniline is pure. It burns with a smoky flame, but is not very inflammable; its boiling-point is 182° C. One of its most characteristic reactions is its power of producing a blue or blue-violet colouration with chloride of lime, to which I shall again have occasion to refer. Aniline differs entirely from benzol and nitrobenzol, being perfectly soluble in dilute acids. This is owing to its being an organic base, and forming compounds with acids. Thus, with hydrochloric acid, it forms hydrochlorate of aniline; with sulphuric acid, sulphate of aniline, &c.

We will now, in a very rapid and general way, glance at the chemical changes which take place in connecting benzol with nitrobenzol and aniline.

Benzol, as I have already stated, is a hydrocarbon, *i.e.*, a body composed of hydrogen and carbon only; it is represented by C_6H_6. This is treated with nitric acid, which contains HNO_3.

The nitric acts upon the benzol and introduces its nitrogen and part of its oxygen, at the same time removing hydrogen and forming water.

$$\underbrace{HNO_3}_{\text{Nitric acid.}} + \underbrace{C_6H_6}_{\text{Benzol.}} = \underbrace{C_6H_5NO_2}_{\text{Nitrobenzol.}} + \underbrace{H_2O}_{\text{Water.}}$$

Nitrobenzol, when treated with iron and acetic acid, is converted into aniline by the influence of hydrogen gas, in what is termed the nascent state, or the peculiar condition in which it is when being liberated from a compound.

This hydrogen unites with the oxygen of nitrobenzol and removes it as water, and at the same time two atoms of hydrogen combine with the deoxygenated nitrobenzol, forming aniline.

$$\underbrace{C_6H_5NO_2}_{\text{Nitrobenzol.}} + H_6 = \underbrace{C_6H_7N}_{\text{Aniline.}} + 2H_2O$$

Having now seen the various operations which require to be performed for the production of aniline from coal-tar, we are prepared for the consideration of its coloured derivatives. We will, therefore, commence at once with the first of the coal-tar colours, "the mauve dye." I have already given you the history of its discovery; I will now tell you how it is made.

First of all aniline and sulphuric acid, in the proper proportions for the formation of sulphate of aniline, are mixed in a large vat with water, and boiled until perfectly dissolved. Bichromate of potassium is then dissolved in a second large vat. These two solutions, when cold, are mixed in a third and still larger vessel, and allowed to stand one or two days. In this way a large quantity of a fine black precipitate is formed; this is collected upon shallow filters, well washed with water, and then dried. When dry it is a most unpromising sooty-black powder, and contains various products besides the mauve; the most troublesome of these is a brown, resinous product, soluble in most of the solvents of the colouring matter itself.

At first this resinous substance was removed by digestion with coal-tar naphtha previously to the extraction of the colouring matter, which was afterwards effected with methylated spirits of wine, and the solution thus obtained when distilled left the mauve as a fusible bronze-coloured mass.

When digesting the black precipitate with naphtha or strong spirits of wine, the operation had to be performed in closed vessels under pressure or in connection with a condensing arrangement, otherwise large quantities of these valuable solvents would have been lost; and great difficulty was experienced in getting apparatus perfectly tight, on account of the "searching" character of these fluids. Substitutes had also to be found for the ordinary materials employed by engineers for making good manhole joints, and a number of other matters which are apparently of but small importance, but it is remarkable the amount of difficulty and annoyance they caused. The method of extraction has, however, been materially improved upon by substituting dilute methylated spirits of wine for strong, as this weaker spirit dissolves only a small quantity of resinous matter but all the colouring matter, so that the digestion with coal-tar naphtha is now found unnecessary.

The solution of the colouring matter in dilute spirit is placed in a still and the spirit distilled off, the colouring matter remaining behind in aqueous solution; this is filtered and then precipitated with caustic soda. It is afterwards collected on a filter, washed with water, and drained until of a thick pasty consistence, and, if necessary, dried.

The solid mauve dissolves very freely in spirits of wine, forming an intensely coloured solution; it is also soluble to a small extent in water, but the aqueous solution on cooling forms a kind of jelly.

The formation of the mauve or aniline purple by the action of bichromate of potassium upon sulphate of aniline is a process of oxidation, and since the publication of the original specification at the Patent Office a great number of patents have been taken out for the preparation of this colouring matter, in which the bichromate has been replaced by other oxidising agents, as peroxide of lead, permanganate of potassium, peroxide of manganese, chloride of lime, ferrocyanide of potassium, chloride of copper, &c.; but I need not make any special remarks upon these various processes, as experience has shown that bichromate of potassium and a salt of aniline, the reagents first proposed, possess advantages over all others, and are now nearly universally employed for the preparation of aniline purple. The next best process appears to be that of Dale and Caro, in which chloride of copper is employed.

The affinity of aniline purple for silk or wool is very remarkable; and, if I take some wool, and pass it through a solution of mauve, you will see how rapidly it absorbs it, even from a very dilute solution. Aniline purple is sent into the market in three different conditions—in paste, in solution, and in crystals; but the latter are very rarely employed, as they are very expensive, and do not offer corresponding advantages to the consumer.

The mauve is the most permanent coal-tar purple known, especially with respect to its power of resisting the action of light.

I will now endeavour to give you some idea of the approximate amount of the various products we have considered obtainable from 100 lbs. of coal; and, for this purpose, I have arranged them in the following table, with their respective weights:—

	Lbs.	Ozs.
Coal	100	0
Coal-tar	10	12
Coal-tar naphtha	0	8½
Benzol	0	2¾
Nitrobenzol	0	4½
Aniline	0	2½
Mauve	0	0½

You see the smallness of the amount of colouring-matter obtainable from coal or coal-tar; but there is fortunately one thing which to some extent compensates for this, and that is the wonderful intensity of this colouring-matter. I will illustrate this remarkable fact. I have here a large carboy, containing 9 gallons of water, and will now add to this a solution containing 1 grain of mauve, and illuminate the liquid with the magnesium-lamp; and you see the single grain has coloured this large bulk of water. A gallon of water contains 70,000 grains; therefore 9 gallons contain 630,000 grains. This solution, then, contains only 1 part of mauve to 630,000 of water.

I have now shown you the manifold operations which have to be performed before we can derive the mauve

from coal-tar, and have also mentioned a few of the obstacles which had to be overcome before its manufacture on the large scale could be accomplished. We have thus laid the ground-work of our subject; and, in our next lecture, I hope to tell you a little more about mauve, and then give an account of the many other colouring-matters of which it may be considered the parent.

(To be continued.)

NOTICES OF BOOKS.

Report on the Quality of the Kerosene Oil sold in the Metropolitan District (New York). By C. F. CHANDLER, Ph.D., &c., New York: D. Appleton and Co. 1870.

THIS paper is a report made by the author in his capacity of Chemist to the New York Board of Health, by which he was instructed to investigate the quality of the Kerosene sold in the city and neighbourhood of New York. The author treats of the composition and varieties of petroleum, on the refining of that liquid, on the quality of kerosene oil, and on the processes vaunted for rendering benzine non-explosive, all of which are perfectly worthless; and, next, enters into the details of the investigation of seventy-eight samples of kerosene oil obtained from the same number of retail dealers. Not one of these samples is safe; all samples contained benzine, gasoline, and naphtha to more or less extent; and only one sample (No. 79), also obtained from a retail dealer, was free from these admixtures, and contained only pure burning oil, usually known in this country as paraffin or crystal oil. The reporter next relates a series of experiments made with the view of ascertaining to what temperature the burning oils become heated in the reservoirs of the lamps in which they are used, different kinds of lamps being employed for this purpose. From these experiments we learn that, even while burning for seven hours, the temperature of the oil does not rise to above 90° F., and that, therefore, an oil which does not evolve an explosive vapour below 100°, and does not take fire itself below 110°, is perfectly safe.

The author next touches the subject of legislation on this matter, first quoting, from the British Acts of Parliament, the directions for applying the flashing test to samples of petroleum oil, and afterwards alluding to the Bill before the State Senate of New York, and discussing some points of interest to the inhabitants of that state. Very properly, the author reflects upon the bill as simply to be made applicable to New York and Brooklyn; it is not only against general good policy, but is a downright infringement of a fundamental constitutional principle, to legislate only for a portion of the inhabitants of a state, or even to make so-called Permissive Acts. These are simply a remnant of feudalism which made slaves and serfs of the bulk of the people, inhabiting the same country, and acknowledging the same person as sovereign.

CORRESPONDENCE.

LOSS OF SODIUM IN SODA-WORKS.

To the Editor of the Chemical News.

SIR,—In the "Chemical Notices from Foreign Sources" given in the CHEMICAL NEWS (vol. xxii., p. 21) appears a brief abstract of the results obtained by M. A. Scheurer-Kestner on the "Loss of Sodium Resulting from its Manufacture according to Le Blanc's Process." The results arrived at by this chemist (viz., that the formation of insoluble sodic compounds which remain in the lixiviated refuse constitutes a very large item in the total causes of loss, and that the volatilisation of sodium is inappreciable) are, in the main, identical with those formerly obtained by the writer, and published in the *Journal of the Chemical Society* (August, 1867); the results obtained during the manufacture of some 5000 tons of soda-ash being:—

PREVIOUS TO LIXIVIATION.

	Per cent.
Undecomposed sodic sulphate	3·49
Insoluble sodic compounds..	5·44
Vapourisation of sodic compounds, &c. ..	1·14

DURING AND AFTER LIXIVIATION.

Soluble alkali left in vat-waste	3·16
Oxidation of sulphide	inappreciable
Leakage and losses during white-ash process	6·56
Total loss	20·24

I am, &c.,

C. R. A. WRIGHT, D.Sc.

Washington Chemical Works, Washington Station, Durham, July 11th, 1870.

MISCELLANEOUS.

London Institution.—Our readers will be glad to hear that Mr. J. C. Brough has been appointed Librarian and General Superintendent of the above-named institution.

Utility of Lightning Conductors.—The *Moniteur Belge* of the 6th inst. contains the following:—The powder magazine Santo-Spirito, at Venice, containing no less than 300,000 kilos. (fully 300 tons) of gunpowder, was struck by lightning the other day. The electric discharge fortunately fell on the lightning conductor, the platinum point of which was molten and the rod split and twisted, but no other damage was sustained. The quantity of powder present, if exploded, would go far to lay in ruins ten cities of the size of Venice.

Quality of the Gas Supplied to the Metropolis.—Dr. Letheby, the Chief Gas Examiner for the Metropolis, has recently reported to the Corporation and to the Metropolitan Board of Works on the quality of the gas supplied to the Metropolis by the Chartered, the Great Central, and the City of London Gas Companies. The average illuminating power of the gas, when burnt at the rate of five cubic feet per hour from Sugg's improved Argand burner has been as follows:—The common gas of the City Company has been equal to 17·55 standard sperm candles; that of the Chartered Company, at Leadenhall Street, has been 17·44 candles, at Gray's Inn Lane, 16·92 candles, at Arundell Street, Haymarket, 17·14 candles; and that of the Great Central Company, 17·82 candles. The illuminating power of the Cannel gas of the Chartered Company has been 24·44 candles, and of the City Company 28 candles. As regards impurity, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, although the amount of sulphur in other form than the last named, has varied considerably; for while it amounted to an average of only 12·29 grains per 100 cubic feet of the Great Central gas, and 12·71 grains per 100 feet of the Cannel gas from the City Works, it reached to 22·13 grains, 22·39 grains, and 29·65 grains in the gas of the Chartered Company at the three testing stations of Leadenhall Street, Gray's Inn Lane, and Arundell Street. In connection with this important part of the subject, Dr. Letheby reports that the testing of the gas of the several companies for sulphur during the last twelve months has shown how this obnoxious impurity may be influenced by different methods of purification; for in the case of common gas, the

average proportion of sulphur in the gas from the Great Central Works has only been 12·91 grains per 100 cubic feet, whereas in the gas of the Chartered Company it has ranged from 21·41 grains to 28·59 grains per 100 cubic feet—the average for all the stations of that company being 24·77 grains, and of the City Company 19·75 grains. And again, although the average amount of sulphur in the Cannel gas of the City Company has been but 10·29 grains per 100 cubic feet, it has reached to an average of 24·48 grains in that of the Chartered Company. These large differences are, according to Dr. Letheby, entirely owing to the different methods of purification, and he directs attention to it as a matter of great practical importance.

The other impurity, ammonia, has been always absent from the common and the Cannel gas of the City Company, but it has been frequently present in the gas of the other companies, averaging 0·38 of a grain per 100 cubic feet of the Great Central gas, and from 1·87 to 3·68 grains in that of the gas from the different stations of the Chartered Company; in fact, it has exceeded the prescribed amount of 5 grains per 100 cubic feet, on seven occasions in the Chartered gas at Leadenhall Street, and on nine occasions in the same company's gas at Gray's Inn Lane.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, July 4, 1870.

This number opens with a report on the—

Pyramids of Villejuif and Juvisy.—M. Delaunay.—In the year 1670, M. Picard took, as basis of his geodesical triangulations, the nearly straight roadway which joins together the communes of Villejuif and Juvisy, a distance of 5748 toises (1 toise is equal to 6 feet 6 inches English measure). This basis having been verified in 1740, by J. Cassini and A. La Caille, they erected there, at the expense of an old scientific institution, re-modelled afterwards into the Academy of Sciences, two pyramids, which, having become out of repair, have now been restored, and on each is placed a black marble slab, containing, in gilt letters, simply the following inscription (translated):—"Pyramid of Villejuif; northern limit of the geodesical basis of Villejuif to Juvisy. 1670—Picard. 1740—J. Cassini and La Caille. Property of the Academy of Sciences." The inscription on the Juvisy pyramid is similar. Both these monuments are about 10 metres high, and are situated on the side of the carriage road leading from Paris to Fontainebleau. There is a very great deal of scientific interest attached to the basis alluded to, it having been the first work of the kind ever accurately done, and thus the basis of nearly all such measurements.

Kinds of Rocks met with during the Boring of the Tunnel through the Western Alps between Modane and Bardonèche.—Elie de Beaumont.—A very lengthy paper, accompanied by a catalogue of the specimens of rocks which have been presented to the Academy, and will in future form a most important mineralogical collection; the more so, because the tunnel, usually known as the Mont Cenis tunnel, will be lined over its entire length (12,220 metres) with bricks and tiles, and the rocks will be hid. As may be expected, this paper, by so eminent a geologist and mineralogist, is of very great value.

Answer to the Remarks made by M. H. Sainte-Claire Deville on the Variations of Temperature Produced by the Mixing of Two Liquids.—Dr. Jamin.—And—

Reply to that Memoir by M. H. Sainte-Claire Deville.—We can only give the titles of these polemical discussions between the rival physicists.

Action of Water upon Iron, and of Hydrogen upon Oxide of Iron.—(Third memoir on this subject).—H. Sainte-Claire Deville.—The author resumes the results of his experiments in the following terms:—The increase of the tension of hydrogen formed by the contact of iron and steam, is a continuous phenomenon when the tension of the steam is made to vary progressively without any variation of the temperature of the iron. That the tension of the hydrogen corresponding to an invariable tension of steam, decreases continually when the temperature increases progressively. That the same laws are observed at the inverse phenomenon of the reduction of oxide of iron by hydrogen.

Isomers of Cyanuric Ethers.—Reply to M. S. Cloëz, by Prof. A. W. Hofmann.

Meteorology of the Spring of the Current Year.—M. Chapelas.—The author considers (1) the temperature, (2) the direction of the winds, (3) the moisture, and draws up a series of comparisons, taken from the meteorological records of former years, to elucidate the meteorological conditions of last spring.

On a Property of the Volta Electrical Condenser hitherto Unnoticed.—P. Volpicelli.—An algebraico-physical memoir.

Deluc's Thermometer.—M. Legrand.—A discussion on the precision of a thermometer scale now almost obsolete, so that this paper is of very little interest.

Compressibility and Expansion of Gases.—Dr. Amagat.

Phospho-Platinic Compounds.—P. Schützenberger.—The author states that he has succeeded in isolating the radical of phospho-platinic compounds before alluded to. The radical turns out to be a black-coloured body, insoluble in water and soluble in alcohol; the formula being $Ph(C_2H_3O)_2Pt$.

Carbonic and Alcoholic Fermentation of Acetate of Soda and Oxalate of Ammonia.—A. Béchamp.—This lengthy memoir is divided into the following sections:—Carbonic and alcoholic fermentation of acetate of soda; carbonic and alcoholic fermentation of oxalate of ammonia; production of alcohol from the elements of air and water. As regards this latter point, the author asserts that he took very pure distilled water, and poured it into a flask, the mouth of which was simply covered by a piece of paper; after having been set aside for some six months, the author has extracted enough alcohol from the water to ignite. He supposes the cause of this phenomenon to be the formation of microzymas, which induced fermentation. Some ammonia and a volatile acid were simultaneously formed.

Climate of the Elsasz and the Vosges.—C. Grad.

Observation on an Unequal Production and Difference of Composition of the Milk from the Breasts of the same Woman.—L. Sourdat.—While the quantity of sugar and salts contained in the milk of the two breasts of the same woman does not perceptibly vary, the author has found that the milk of the right breast contains more butter and caseine than that of the left breast, the difference being as much as in the ratio of 9 to 1.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 208, April, 1870.

This number contains the following original memoirs and papers relating to physico-chemical and collateral sciences;—

Report, by M. Tresca, on the System of Water-Wheels Invented by M. Sagebien.—A very important memoir, illustrated by engravings, on this subject, since the inventor has successfully solved the problem of applying usefully low falls, or weak currents of water, so as to become, by means of the wheels arranged by him, fit for very cheap, yet effective, motive power.

Report, by M. Clerget, on an Apparatus wherein a Continuous Jet of Liquid, and a Gradually Increasing or Decreasing Temperature, are Applied to the Cleansing of Linen Fabrics.—Description, illustrated by engravings, of an apparatus invented by M. J. Decoudun, 77, Rue Montreuil, Paris.

Manufacture of Special Kinds of Cast-Iron.—S. Jordan.—The author discusses, at great length, the calorific phenomena produced by the injection of compressed air, steam, or oxygen into a mass of molten iron, from a multiple of jets.

Effervescing Cyder.—MM. Brosse and Lamfrey.—Cyder, it is well known, becomes, when bottled, after being freshly-made and pure, effervescing to a high degree, but then, also, a highly-intoxicating beverage. The authors apply to cyder a preparation (not specified) whereby it becomes effervescent and a pleasant useful beverage which keeps well for any length of time.

Gaize.—J. Desnoyers.—The substance known as gaize, or *pierre morte*, is a mineral largely met with in the department of the Ardennes, where it forms a deposit of some 100 metres' thickness. Its sp. gr. is 1·48, and it consists, in 100 parts, of—Soluble silica, 44·8; insoluble silica, 42·0; alumina, 5·1; peroxide of iron, 2·5; lime, a trace; hygroscopic and combined water, together, 5·4. It is, on being dug up, quite soft, so that it can be cut with a knife, but becomes hard on drying, and very hard when exposed to red-heat, whereby its specific gravity is reduced to 1·44. This material is essentially a substance capable of withstanding high temperatures; and the author exhibits crucibles made from the gaize, which have been used successfully for melting iron. Dr. La Salvetat, the celebrated chemist of the Imperial Porcelain Works, at Sèvres, states that layers of similar material exist in the central parts of France, likewise deposited in the cretaceous formation; he also states that these minerals are of great value for the construction of blast and other furnaces.

Alloy of Cobalt and Manganese.—A. Valenciennes.—The author exhibits, at the meeting of the Society, samples of metallic cobalt and manganese, and alloys thereof, as well as alloys of copper and manganese, which resemble those of copper and tin. The alloys of cobalt

and manganese are not likely ever to become (the author states) objects of general use; but those of manganese and copper possess properties whereby they may become generally employed.

Annales de Chimie et de Physique, June, 1870.

This number contains the following original papers and memoirs:—

Superficial Tension of Liquids, as deduced from Certain Movements which Take Place on their Surface.—G. van der Mensbrugghe.—The concluding portion of this memoir.

Indices of Refraction of Gases and Vapours, and on the Measurement of their Dispersion.—Dr. M. Croullebois.—This lengthy essay is divided into the following chapters:—The history of the subject; description of instruments, illustrated by woodcuts; indices of gases for homogeneous lights; dispersion of gases; first method, and observations thereon; second method; indices of gases in white light; indices of vapours in homogeneous and white lights; dispersion of vapours, method employed, and description of apparatus, illustrated by woodcuts.

Apparatus Arranged for the Demonstration of the Physical Properties of Vapours.—F. da Fonseca Benevides.—This paper cannot be understood without the reproduction of the annexed cut. The contrivance is simple and effective, and suited to demonstrate, experimentally—The laws of the boiling of liquids and absorption of latent heat; the influence of pressure upon the temperature of the boiling liquid; condensation of vapours (steam and others); development of latent heat; relation between pressure and temperature; production of cold by the dilatation of vapours under high pressure; use of steam as motive power; action of the Giffard's injector.

Evaporation of Water and the Decomposition of Carbonic Acid by the Leaves of Plants and Trees.—P. P. Dehérain.—This lengthy memoir, containing a series of results of experiments exhibited in a tabulated form, is divided into the following sections:—History of the subject, method of experimenting; quantity of water evaporated by leaves exposed to sunlight in one hour; influence of light upon the evaporation. The luminous rays which provoke the evaporation also cause the decomposition of the carbonic acid. Rays of light of the same intensity, but different colour, exert different action, as regards the decomposition of carbonic acid and the exhalation of water.

Estimation of Graphite in Carburetted Iron.—M. Boussingault.—The results of the experiments and analyses detailed at length in this paper, may be summarised as follows:—(1) When a carburetted iron is dissolved in chlorhydric acid, the total quantity of the carbon combined with the metal is eliminated, while the free carbon remains mixed with the other substances insoluble in the acid. (2) Since the residue left by a grey cast-iron, treated by hydrochloric acid, contains a portion of the silicium which was combined with the iron in the state of silica, that residue does not contain any graphitoid silicium nor protoxide of silicium; the estimation of the silica in the residue does not represent the whole of the silicium contained in the cast-iron, because a portion of the silica remains in the acid liquid. (3) That the process based upon the difference of combustibility of the combined carbon and graphite is sufficiently exact to estimate the two kinds of carbon obtained by the action of bichloride of mercury upon the carbonaceous residue of cast-iron or steel.

Annalen der Physik und Chemie, von Poggendorff, No. 5, 1870.

This number contains the following original papers and memoirs—

Sound Emitted from Heated Tubes, and on the Oscillation of Air in Pipes of Different Shape.—Dr. C. Sondhauss.

On Chromates.—C. Freese.—The author has studied some of the hitherto less known salts of chromic acid. Among these we notice—Normal chromate of silver: Attention is called to the mode of precipitating this salt, which differs in composition with the concentration of the silver and chromate solution employed; the normal salt contains 65 per cent of silver and 15·83 per cent of chromic acid. A basic chromate of silver does not exist; a bichromate is well known. Chromate of protoxide of mercury, $HgCr_4O$, in 100 parts—Hg, 77·49; Cr, 10·11; O, 12·40. Chromate of deutoxide of mercury, $3HgCr_6O$, in 100 parts—Hg, 80·19; Cr, 6·98; O, 12·83. The chromates of copper are treated of at great length, and the subject is to be continued in a following number.

Thermo-Chemical Researches.—J. Thomsen.—The continuation of the author's very lengthy memoir on this subject, this portion treating on the acids of nitrogen, phosphorus, and arsenic.

Continued Researches on Liquid Conductors of Galvanic Electricity.—J. W. Müller.—The first instalment of a lengthy essay on this subject, subdivided as follows:—Introduction and description of method of investigation, illustrated by diagrams; on the tension of liquid conductors in general; the non-dependence of the tension of alkali and acid upon their chemical combination; first general laws of the direction of the current, and of the electro-motive force of the acido-alkaline conductors; tensions of the alkalies and the acid, and of the salts formed by their union; saline solutions at the end of each pair of metals; effect of dilution of saline solution; effect of concentration of saline solution.

Investigation on the Electric Dust Figures (Staubfiguren).—W. von Bezold.

Laws of the Formation of Kundt's Dust Figure.—T. Karrass.—These two papers refer to what are sometimes termed Lichtenberg's figures, but the contents of neither of them are suited for any useful abstraction.

Description of Electrophoric Machine Suitable to Charge Batteries.—P. Riess.—Illustrated with woodcuts.

Measurement of the Absorption of Light by Transparent Media by means of the Spectrum Apparatus.—Dr. C. Vierordt.

Observations on Induction Sparks.—Dr. A. Weinhold.

Annalen der Chemie und Pharmacie, May, 1870.

This number contains the following original memoirs and papers:—

Researches on some of the Derivatives of Cinnamic Acid.—C. Glaser.—Third part of this essay, divided into the following sections:—Phenyl-propiolic acid, $C_9H_6O_2$; formation of phenyl-propiolic acid from β bromstyrol; formation of phenyl-propiolic acid from α bromo-cinnamic acid; constitution of phenyl-propiolic acid; formation of acetenyl-benzol from phenyl-propiolic acid; formation of acetenyl-benzol from styrol; metallic combinations of acetenyl-benzol and its conversions (diacetenyl-phenyl; synthesis of phenyl-propiolic acid); derivatives from styrol; chlorinated styrols; brominated styrols; conclusions and speculative discussions.

On Mercuro-Ditolyl.—E. Dreher and R. Otto.—This compound—

$$C_6H_4\begin{cases}CH_3\\ \\ Hg\end{cases}C_6H_4\quad\text{(}CH_3\text{ on the lower branch)}$$

is obtained by the action of sodium-amalgam upon brom-toluol. It is, as crystallised from boiling benzol, a beautifully white body, exhibiting a strong diamond-like lustre, and crystallising in large rhombic-shaped crystals, insoluble in water, difficultly so in alcohol, best in benzol, chloroform, and sulphide of carbon, and fuses at 235°. The authors describe, at length, the action of the haloids, and of nitric, hydrochloric, hydriodic, and sulphuric acid upon this body; and next treat of acetic acid-mercuro-monotolyl—

$$C_6H_4\begin{cases}CH_3\\ \\ Hg\end{cases}C_2H_3O-O$$

a white crystalline substance, fusing at 153°; insoluble in cold, but more soluble in boiling, water; best soluble in alcohol, sulphide of carbon, and benzol. The paper winds up with an account of researches made with the view of preparing mercuro-dibenzyl—

$$\begin{matrix}C_6H_5-CH_2\\ \\ Hg\\ \\ C_6H_5-CH_2\end{matrix}$$

Behaviour of Dibenzyl at a High Temperature.—E. Dreher and R. Otto.—The main fact of interest in this paper is that dibenzyl is split up, by heat, into toluol and toluylen, according to the formulæ—

$$2\begin{pmatrix}C_6H_5-CH_2\\ |\\ C_6H_5-CH_2\end{pmatrix}=2C_6H_5-CH_3+\begin{cases}C_6H_5-CH\\ \|\\ C_6H_5-CH\end{cases}$$

Conversion of Thiophenol (Phenyl-Sulphydrate) into Phenyl-Bisulphide.—E. Dreher and R. Otto.—After referring to the different methods of effecting the conversion alluded to, the authors state that this object can also be attained by heating the mercurial compound, $(C_6H_5)_2S_2Hg=(C_6H_5)_2S_2+Hg$.

Two Isomeric Pentachlorbensols and Bichlorbenzol-Chloride.—R. Otto.

Mercuro-Dinaphthyl.—R. Otto.—This paper is divided into the following sections:—Preparation of mercuro-dinaphthyl; action of iodine upon mercuro-dinaphthyl; mercuro-mononaphthyl-bromide; behaviour of mercuro-mononaphthyl-iodide with nascent hydrogen and sodium-amalgam; formic and butyric acids, mercuro-mononaphthyl.

Sulpho-Toluide.—R. Otto and A. Gruber.—Sulpho-toluide, $C_{14}H_{14}SO_4$, is, when obtained in crystalline state from benzol, a solid body, exhibiting klinorhombic-shaped prismatic crystals; fuses at 155°; insoluble in water, and difficultly soluble in cold alcohol and ether; rather more soluble in boiling alcohol, benzol, and chloroform. When submitted to the action of heat, in small quantities, it is volatile without decomposition. Heated along with concentrated sulphuric acid, it is gradually converted into toluol-sulphuric acid. The authors quote, at length, the various reactions of this body with several reagents, and discuss its constitution.

Acetic Acid Mercuro-Monomethyl and Acetic Acid Mercuro-Monoethyl.—R. Otto.

Preparation of Organic Sulphur Compounds by means of Hyposulphite of Sodium.—R. Otto.—When ethyl-alcohol is heated for twenty hours, in a sealed tube, with a hot concentrated solution of hyposulphite of soda, it is converted into mercaptan. Iodethyl, heated for two hours to 150°, in a sealed tube, is converted into sulphur compounds, and iodide of sodium is formed.

Diamido-Nitrophenylic Acid, a New Derivative from Picric Acid.—P. Griess.

Azobenzol-Sulphuric Acid.—P. Griess.

Ozone and Antozone.—C. Engler and O. Nasse.

Constitution of Arbutine.—H. Schiff.

Action of Hypochlorous Acid upon the Chloride of Allyl.—H. von Geyerfelt.

New Mode of Synthesis of Naphthalin-Carboxylic Acid.—A. Eghis.

New Method of Estimation of Grape Sugar.—K. Knapp.—This method is based upon the fact that an alkaline solution of cyanide of mercury is completely reduced to the metallic state by grape sugar. The method is executed as follows:—10 grms. of pure and dry bicyanide of mercury are dissolved in pure distilled water; to this solution are added 100 c.c. of caustic soda solution (sp. gr., 1·145); and, next, as much distilled water is added as will be required to make a bulk of 1000 c.c. A series of experiments made by the author brought to light the fact that 400 milligrms. of cyanide of mercury are, when in alkaline and boiling solution, completely reduced to metal by 100 milligrms. of pure grape sugar. The titration is done as in Fehling's method—40 c.c. of the alkaline cyanide solution are boiled in a porcelain basin; and the sugar solution (not stronger than about half a per cent) is added until all the mercury is precipitated. In order to test the course of the operation, a single small drop of the fluid is put upon a piece of Swedish filtering paper stretched over the mouth of a small beaker-glass, while the bottom of that glass is covered with rather strong sulphide of ammonium. As long as any cyanide remains undecomposed, a brownish spot will appear. The author states that, with a little practice, even 1-10th c.c. of the above dilute sugar solution can be readily estimated.

Cosmos, June 18, 1870.

Bicoque Insubmersible.—J. Chabassière.—The author describes, under the above title, at great length, a peculiarly-constructed ship, so contrived as to be really incapable of foundering; and, even when knocked to pieces, its component parts (the passengers' cabins) are so constructed as to constitute floating vessels, each separately. Experimental trials with a vessel made according to the author's suggestions are being performed at Algiers.

The Silex (Flints) of the Chalk considered as Living Bodies.—Rev. P. Sun.—The author thinks that the flints of the chalk may be considered as being the work and production of living beings, similar to the coral reefs found in the ocean, and that, after the death of the microzymas (elementary living organisms) present in the flint, the latter becomes what is termed gaize, or dead stone. This view is strongly combated by many eminent geologists of our time.

Scientific Visit to be made to England.—The French Minister of Marine has ordered that a number of select officers, of all grades of the French navy, shall proceed to England, with the view of visiting, not only dockyards, but also all scientific establishments and institutions which are related to, or work for, the benefit of navies (war and mercantile), and to make a report of their proceedings and investigations.

June 25, 1870.

This number does not contain any original papers or matter relating to physico-chemical sciences.

July 2, 1870.

Vintage of Wines.—J. Guyot.—The author's chief aim is to point out, as regards wine, the danger to health of adding to these fluids (as is usually done for the wine intended for exportation), alcohol, to a greater or less extent. The author expatiates upon the fact that all animal and vegetable products, when brought to a state of chemical purity and stability, are unfit to serve as food, and that the wine consumed in the country districts is sedulously left *au natural*, even if its quality is mediocre. All who are acquainted with wine-growing countries, and the trade there, know very well that, for every special port of shipment (at least, those belonging to one and the same country), wine is purposely (not as an adulteration, but as a necessity which has sprung into use) prepared for such or such port of shipment, and that this essentially consists in the addition of more or less alcohol, and, sometimes, wines previously boiled with sugar for some time. The author observes that, to make a wine keep is to kill it, it being a well-known fact that many small wines are only good during their first year of existence, but do not last above a twelvemonth. Such a wine is active; and it is just that activity which makes it a wholesome beverage which neither affects the head nor the stomach.

Proposed Law Concerning the Free Teaching of Higher Sciences.—This paper, too long for any but brief notice, is an evident proof of that pre-eminence which the Frenchmen possess of making laws so as to be brief, readily understood by all, and worded so as not to lead to litigation or difficulties. Of course, from men of the stamp of MM. Guizot, Dumas, Duruy, and others, no one could expect but a highly-efficient plan, which will, undoubtedly, be a great boon to "La Belle France."

Proposal to Decrease the Existing Drought by Accelerating the Melting and Floating-Down of the Ice in the Polar Seas.—V. Prow.—The author seriously proposes to blow up, by means of dynamite, icebergs and ice-fields in such masses, in the Arctic Regions, as to cause the loose ice to float into the Atlantic, and there to cause, by its rapid melting, such a cooling of the atmosphere and sea as to conduce to the formation of rain. The author has certainly never witnessed the almost total inefficiency of both heavy bombardment of ice-dams, or attempts to blow them to fragments by explosions of gunpowder. Some twenty-four years ago, thaw having set in, experiments were made (as had been often done before) to remove, by the means alluded to, ice-dams on the lower Rhine and some of its branches, the removal of which was absolutely required in order to prevent serious inundations and breaking of embankments; but, although directed by military men of great skill in these matters, these means proved quite ineffective, and it was only by natural causes that the obstruction was removed in time.

Laboratory Accident.—It appears that a pupil of the School of Pharmacy, named Tronçay, was engaged in heating, in a glass tube, a solution of hyposulphite of soda mixed with nitric acid. While trying to smell, at the mouth of the tube, the odour of the sulphurous acid given off, a sudden ebullition of the liquid took place; as a consequence of which, the contents of the tube were forced out at its open end, with the sad result of seriously burning the eyes of the young man occupied with the experiment. Notwithstanding the immediate aid given by a medical man who happened to be at the school at the time, the young man has lost his eyesight.

Statistics of Berlin University.—Without specifying for all faculties, this University now has a professorial staff of 165 men, the largest number being engaged with the philosophy faculty (literature and sciences together), which has 26 ordinary and 31 extraordinary professors, and 20 private (graduated) teachers. In addition, there are 3 masters of living languages, and 3 masters for dancing, music, and gymnastics.

A Burning Mountain.—S. Meunier.—The author states that Mount Vuache (Savoie), near Savigny, has been, for a fortnight past, actually burning—that is to say, it is not, as might be, some fire of dry grass, heather, or trees, but the body of the mountain itself is in flame, and emits a dense smoke to such an extent, that a surface of some 800 square metres is red-hot, and so frightens the people who live near, that the true cause has not been ascertained at present. Some think the mountain has become a volcano.

Application of the Ash and Small Coke of Gas-Works for Brick-Making.—O. Wagner.—The author mixes from 10 to 12 parts of the ash and cinders with 1 part of lime, after having first taken care to break up the small pieces of coke, so as to be of no more than about 5 centimetres cubical size. The mass is mixed with some water, and next mixed in a pug-mill, and, after having become stiff enough, formed into bricks by a brick-making machine. The bricks are slowly, but carefully, dried, and are, after drying, fit for use, making very solid walls, while the material is very light, and especially suited for partition walls.

NOTES AND QUERIES.

Cement.—Can any of your correspondents kindly inform me if there is any known cement that will resist boiling nitric acid?—C. H.

Benzol.—Can any one inform me what kind of apparatus is required for testing the percentage of benzol in naphtha, and where to get them and a book of directions how to test it?—A Subscriber.

Inflammable Liquids.—Can you inform me whether there is any liquid preparation known that will take fire, spontaneously, on coming into contact with water; or whether there are two liquids, by themselves inflammable, but otherwise when brought together?—G. G. M.

Extract of Meat.—Will you kindly inform me how the extract of meat, now being sold under the name of "Liebig's extract," &c., is made? It appears to be a totally different article to anything like the old-fashioned concentrated soup.—Thos. Wells.

Work on Sulphur.—(Reply to "George Crampton")—You will find in the latest edition of Payen's "Chimie Industrielle" what you desire; but bear in mind that, unless you have fuel at an exceedingly cheap rate, the extraction of sulphur from the substances alluded to does not pay. You can inspect the work alluded to at the Library of the Commissioners of Patents.

Estimating Sulphide and Sulphite of Calcium.—(Reply to "Alkali.")—You cannot mean exactly what this question states. It must be evident that the process of oxidation will certainly result in the formation of sulphate of lime, rather than of sulphite, and there will then be no possibility of estimating what, previous to that oxidation, was already a far more complex mixture of substances than you suppose; and you will readily understand, therefore, that there is no such method as you desire to be informed upon.

TO CORRESPONDENTS.

Chrome Alum.—This is common alum in which chromium takes the place of aluminium.

A Subscriber.—Good ventilation is your only remedy.

Alfred W. Bennett.—We were glad to hear from you.

E. Sonstadt.—Thanks for your communication. We shall be glad to have your complete paper.

George Gore, F.R.S.—We will send you a reply by post.

L'Abbé F. Moigno.—You have doubtless received the parcel ere this. After making the enquiries, we will write to you.

A. H. Church.—Received, with thanks.

The Secretary of the Aëronautical Society of Great Britain is thanked for his communication.

W. H. Walenn.—Next week.

A Subscriber from the first.—The address of Mr. Siemens is 3, Great George Street, Westminster. You will find a complete description of his furnace, and its successful use, in Vol. III. of "A Practical Treatise on Metallurgy," by Crookes and Röhrig, published by Longmans and Co.

The Honourable the Commissioners of Patents, Washington.—We have received, through Mr. B. F. Stevens, the four volumes of your *Reports* for the year 1867; for which please accept our thanks.

S. E. Phillips.—Your paper shall, if possible, be inserted next week.

THE CHEMICAL NEWS.

VOL. XXII. No. 556.

NOTE ON SOME NEW DERIVATIVES OF ANTHRACENE.

By W. H. PERKIN, F.R.S.

In the latter part of last year, when experimenting upon the production of alizarine from anthracene, I obtained some interesting reactions, which I described in a Patent dated November 17th, 1869. In this note I propose to give a short account of the chemical changes which take place in some of these reactions, leaving the experimental details to a future occasion.

When dichloranthracene is mixed with fuming sulphuric acid, it gradually dissolves, forming a green fluid, which, upon dilution with water, becomes yellow. The product thus obtained contains one, if not two, new acids, viz., disulphodichloranthracenic acid, $C_{14}H_8Cl_2SO_3$, and monosulphodichloranthracenic acid, $C_{14}H_8Cl_2SO_3$. The formula of the former I have well established, but the existence of the latter is not definitely settled.

Disulphodichloranthracenic acid is of a yellow or orange colour, and easily soluble in water. It is remarkable for the great beauty and intensity of its fluorescence when in dilute solutions. It is dibasic, and forms salts of the formula $C_{14}H_6Cl_2M_22SO_3$. Many of these are difficultly soluble in water, and of a yellow or orange colour.

Dibromanthracene likewise dissolves in fuming sulphuric acid, forming a green fluid containing compounds analogous to those obtained from dichloranthracene, and possessing a strong fluorescence when dissolved in water.

The acids obtained from chlorinated or brominated anthracene, when subjected to the action of oxidising agents, part with their chlorine or bromine, exchanging it for oxygen, yielding disulphanthraquinonic acid,* thus:—

$$\underbrace{C_{14}H_8Cl_22SO_3}_{\text{Disulphodichlor-anthracenic acid.}} + O_2 = \underbrace{C_{14}H_8O_22SO_3}_{\text{Disulphanthra-quinonic acid.}} + Cl_2.$$

$$\underbrace{C_{14}H_8Br_22SO_3}_{\text{Disulphodibrom-anthracenic acid.}} + O_2 = \underbrace{C_{14}H_8O_22SO_3}_{\text{Disulphanthra-quinonic acid.}} + Br_2.$$

When oxidising these sulpho-acids, the termination of the operation is easily seen by the solutions losing their fluorescence.

If dichlor- or dibromanthracene be treated with concentrated or fuming sulphuric acid, and the temperature gradually raised, the disulpho-acids are first formed and then decompose, yielding disulphanthraquinonic acid, thus:—

$$\underbrace{C_{14}H_8Cl_2}_{\text{Dichlor-anthracene.}} + 2H_2SO_4 = \underbrace{C_{14}H_8Cl_22SO_3}_{\text{Disulphodichlor-anthracenic acid.}} + 2H_2O.$$

Then—

$$\underbrace{C_{14}H_8Cl_2,2SO_3}_{\text{Disulphodichlor-anthracenic acid.}} + H_2SO_4 = \underbrace{C_{14}H_8O_22SO_3}_{\text{Disulphoanthra-quinonic acid.}} + 2HCl + SO_2.$$

$$\underbrace{C_{14}H_8Br_2}_{\text{Dibrom-anthracene.}} + 2H_2SO_4 = \underbrace{C_{14}H_8Br_22SO_3}_{\text{Disulphodibrom-anthracenic acid.}} + 2H_2O.$$

$$\underbrace{C_{14}H_8Br_22SO_3}_{\text{Disulphodibrom-anthracenic acid.}} + 2H_2SO_4 =$$

$$= \underbrace{C_{14}H_8O_22SO_3}_{\text{Disulphanthra-quinonic acid.}} + Br_2 + 2SO_2 + 2H_2O.$$

During my experiments I have repeatedly analysed dichloranthracene, and my results agree with those of Graebe and Liebermann, showing that this body is a substitution product of anthracene, and not a product of addition.

Like anthracene, dichloranthracene combines with picric acid, forming a red crystalline product, which, from analysis, appears to consist of $C_{14}H_8Cl_2,C_6H_3(NO_2)_3O$.

* MM. Graebe and Liebermann have lately corroborated my results, and obtained disulphanthraquinonic acid by heating dichlor- and dibromanthracene with sulphuric acid. They do not, however, seem to have recognised the intermediate part of the reaction, viz., the formation of the dichloro- and dibromo- sulpho-acids of anthracene. (*Ber. d. D. Chem. Gesellsch.*, July, 1870, p. 636).

AIR-POLLUTION BY CHEMICAL WORKS.

(Concluded from p. 27.)

Among chemical-works, the largest, and those capable of doing most harm to vegetation, are the alkali-works. In these works, soda, in its various forms of ash, carbonate, bicarbonate, crystal, or caustic, is extracted from common salt. Common salt consists of soda in combination with muriatic acid. When it is mixed with sulphuric acid, and heated, muriatic acid is driven off as a gas. In the earlier days of the soda-manufacture, this acid was considered as a waste product, to be got rid of as speedily as possible. The easiest way was to let it pass into the chimney, and thence into the surrounding atmosphere. Complaints were soon made that trees in the neighbourhood were injured. The manufacturer therefore raised his chimney, building it so high that the acid might be carried away to a great distance by the wind, and its effects lost sight of. The result of this effort was not successful. On wet days, the rain passing through the smoke would wash down the acid, and fall in burning drops even at the foot of the chimney; while, on fine days, the smoke would travel farther, and, though much spread out, still powerful for evil, would carry on its destruction over a larger area. A wiser plan was next adopted. By the use of the now-famous Gossage condensing-towers, the acid-vapours were washed out of the smoke, and kept from contaminating the air altogether. Those alkali-manufacturers who carried out this method well sent out scarcely any acid-vapour to damage the farmers' crops. Some of the manufacturers, however, were behindhand in the movement, and, either from want of skill or of enterprise, did not condense their acid-vapours. Of the efficiency of this condensation in individual cases the farmer could not judge; he found that his crops were still damaged, and therefore brought his action as before, possibly to recover from an innocent party. At this point the Legislature stepped in, and, in the Alkali Act of 1863, passed a measure which has worked well in the interests of both the manufacturers and the agriculturists. The Act announces it to be the duty of the manufacturer to condense 95 per cent of the muriatic acid he produces, and fixes a penalty of £50 for each omission, raising the penalty to £100 after the first conviction. Inspectors are appointed, whose duty it is to visit the works from time to time, and ascertain that the provisions of the Act are carried out. It should be noticed that the Legislature, in passing this Act, stepped out of its accustomed course. The common law maxim is that, for every injury a man may receive, he has his remedy against some one: he must, however, receive the injury before he can seek his remedy. But, in this case, as it already has been shown, much injury may be done which has no remedy. Who can replace an oak-tree of 100 years' growth, and restore the waving woods which adorned the hill-side? The law, therefore, here steps in beforehand; and, no sooner does the inspector find that 95 per cent of the acid is not condensed, than he stops the process under the penalties mentioned. The new law

has been found to work very well. It has enforced the condensation of muriatic acid, to the benefit both of the manufacturer himself and of the public. It has protected the agriculturist against the manufacturer, and the manufacturer against the agriculturist. The inspector is received as a friend by both sides; he protects the farmer's interests by enforcing care on the part of the manufacturer, and he protects the manufacturer's interest by proclaiming the extent to which he carries the suppression of noxious vapours. The Act has had the effect of bringing up the hindermost manufacturer to the rank of the most skilful. Before this legislation took place, many manufacturers condensed a portion of their muriatic acid; now they all condense, not a small portion only, but fully 95 per cent, some, indeed, habitually condense 99 per cent. The manufacturer finds the visits of the inspector an assistance to him in keeping his condensing-apparatus in efficient order; and an amount of acid escaping which would pass unnoticed by the master or his workpeople is detected by the inspector. It should be understood that, to point out leakage of muriatic acid, is to point out waste; for this acid is needed in the manufacture of bleaching-powder and other products. The amount of acid thus saved by the operation of the Act is very large. One manufacturer sells muriatic acid annually to the amount of £1500—acid which, previous to the passing of the Act, was sent up the main chimneys of the works, to the destruction of all surrounding vegetation.

It may now be asked, in general terms, Has the Alkali Act, this somewhat experimental law, succeeded? does it accomplish the work it was intended to do? The reply is that it has done all, and more, than its promoters or those who understood its provisions expected. But probably the public generally are not satisfied: they fail to understand that a law which professes to shield them from muriatic acid cannot also defend them from chlorine, sulphurous acid, sulphide of hydrogen, and the host of nameless gases by which their noses and their gardens are assailed; still less can they understand that an Act which should prevent the emission of muriatic acid from the chimney of an alkali-works cannot also prevent the escape of the same acid from copper-extracting works, a bottle-factory, or a pottery.

The Act must, however, not be blamed for omitting to do that which it was never framed to accomplish. Let us be glad that a step has been gained—that one noxious gas has been measured and suppressed.

Some instances have occurred where manufacturers who are not alkali-makers have desired to place their factories under the inspector appointed under the Alkali Act: their object being first to know if, in his opinion, they were sending out an injurious amount of noxious vapour; then, having diminished it so as to meet with his approval, to gain his advocacy and defence when harrassed by their natural enemies the farmers. This has brought a certain amount of volunteer-work on the inspectors, which they have cheerfully borne on account of the obvious good they could accomplish by diminishing, on the one hand, the escape of noxious acids, and preventing litigation on the other.

In districts such as that around St. Helen's, in Lancashire, where alkali-works and copper-smelting works are found together, the copper-smelters look somewhat enviously at the alkali-makers.

Before the passing of the Alkali Act, the farmers who thought they had suffered loss through the injury of their crops by acid-vapours charged the damage sometimes against the alkali-works and sometimes against the copper-works. Now, however, owing to the improvements which have been made in the alkali-works under the stimulus of the Act, and supposing the manufacturers to be somewhat protected by it, the landholders direct their attacks exclusively against the copper-smelters. The amounts claimed by each farmer are not always large, but the aggregate has reached £3000 a-year against the six copper-works.

Besides these smaller claims, an important action was lately brought, by the proprietor of an estate three miles from St. Helen's, against a copper-smelter, for damage done to his trees and crops by the smoke from the works. The course the action took so well shows the present working of the law, and indicates, perhaps, the direction in which it could be amended, that it might be well to give some account of it here.

The plaintiff proved he had received damage from smoke coming from the direction of the defendant's works, and alleged that the damage he had sustained was wholly done by them, intimating that if he gained a verdict in the present suit he should apply to the Court of Chancery for an injunction to restrain the carrying on of the works altogether, as, he believed, he would then be free from all damage. In defence, it was pointed out that the defendant's works lay in a straight line between the plaintiff's land and St. Helen's, so that the same wind which brought defendant's smoke would also convey the smoke from a large portion of St. Helens; and that, in general, as the plaintiff's park was subject to injury from all the factories in the neighbourhood, it was unjust to charge the whole damage upon the defendant.

It will be seen that the following question would at once present itself:—Is it possible to determine the amount of damage which each factory in a district contributes towards the damage done by all?

In other words, if a farmer sustains a loss of £100 through his crops being injured by the accumulated smoke of a manufacturing district, is it possible to set down to each manufacturer the amount which he ought to contribute towards this £100?

Turning to the fifth of Dr. R. Angus Smith's very able reports under the Alkali Act, we find this question anticipated, and an answer given. Referring to the amount of acid-vapours thrown up with the smoke of factory-chimneys, he says, at page 25:—Now it is easy to estimate this amount; and it is easy to put down to everyone in the district the exact share of guilt, so far as the acid is concerned. . . . . Perhaps we may also bring in the element of distance."

In consequence of this, Mr. Alfred E. Fletcher, the Inspector under the Alkali Act for the district which includes West Lancashire, was asked to apply himself to the question. He had to consider—

1. The distance of each factory from the injured land.
2. The rate at which the increase of distance diminishes the power of the smoke to do damage.
3. The number of days throughout the year on which the wind blows from each point of the compass.
4. The amount of acid-vapour discharged from each factory in a given time.

First, the distances; these are easily measured on the map.

Information on the second point was obtained in the following manner:—At a time when the ground was covered with snow for a week, lines were drawn, in a direction following the wind, from St. Helens, and from other groups of works, to a distance of two or three miles. At each half-mile a sample of the surface-snow was collected, and brought home for analysis. Also, during a period of rain, collecting vessels were set at regulated distances from a group of works. A determination was then made of the amounts of muriatic and of sulphuric acids collected by the snow and by the rain, and these were compared with the distances at which the samples had been obtained It was seen that the amounts diminished in even ratio with the increase of distance. Probably a sufficient number of experiments of this nature have not yet been made firmly to establish the law; for the undulations of the ground, the position of trees, and any objects which interfere with the uniform motion of the air, affect the even deposition of the acid-vapours. More experiments, it was said, were about to be undertaken, in order to establish the law on a wider basis. Information on the third point may be usually obtained at some neighbouring observatory. In

the case of St. Helens, the returns of the direction of the wind published at the Liverpool Observatory, on Bidston Hill, were depended on.

Fourthly, the amount of acid-vapour discharged from each factory in a given time can be known by periodical examination of the gases which are passing up the various chimneys of the works. This is already done, as far as the alkali-works are concerned, under the provisions of the Alkali Act. In the cases of copper-smelting works, glass-works, and others where systematic inspection has not been carried on, the amounts of acid-vapour thrown into the air can be calculated from the materials used in the manufacturing processes carried on.

The acid-vapours discharged from the various works in the St. Helens district are:—From ten alkali-works—muriatic acid, sulphuric acid, sulphurous acid, nitrous acid, chlorine, coal-smoke; from nine glass-works—muriatic acid, sulphuric acid, sulphurous acid, vapour of common salt, coal-smoke; from six copper-smelting works—sulphuric acid, sulphurous acid, coal-smoke; from six collieries, six iron-foundries, two soap-works, eight thousand dwelling-houses—coal-smoke; from the Sankey Brook and the heaps of alkali-waste—sulphide of hydrogen.

This is a formidable list; but the amounts of each may be calculated with a very near approach to accuracy, except the last item, the sulphide of hydrogen, which varies continually with the amount of rain-fall, and with the temperature of the air.

Having, then, collected the information as set forth under these four heads, it became merely a question of figures to apply it to the solution of the problem raised in the St. Helens law-suit. A list was made out of the principal factories in the district capable of doing injury to the plaintiff's land. Opposite these was set down the distance of each factory from the land, and, in a parallel column, the amount of acid-vapour thrown up by each. On dividing the figures in the second column by those in the first, numbers were obtained which were proportioned to the share each one had contributed to the total damage done by all to the plaintiff's land.

Further, a method was adopted by Professor Roscoe, of Owen's College, Manchester, which confirmed the accuracy of this calculation.

St. Helens lies, as has been said, three miles from the plaintiff's park, defendant's works being half-way between them.

While the snow lay on the ground last February, the wind blew mainly from the east. Professor Roscoe then took samples of the snow lying three miles west of St. Helens, and also some of that lying a mile and a half west of defendant's works, that is, the same distance to the west as plaintiff's land is to the south-south-east. He found that the proportion of the amount of acid contained in the one to that contained in the other agreed closely with the proportion determined by Mr. Fletcher in the previous calculation. This was given as evidence at the trial; and it appears that the jury acted on the principle here laid down, that a manufacturer should only be called on to pay in proportion to the amount he contributes to the total damage sustained, and that it is possible to ascertain what that amount should be. Since this trial, two other similar cases have been decided by arbitration: in each of them the arbitrator showed, by his award, that he adopted the principles here set forth.

Having now given some account of the working of the Alkali Act, the most recent legislation on the difficult subject of air-pollution, and sketched the action of the law courts when matters of the kind are brought before them, it may be desirable to discuss the course which further legislation should take in the matter.

As regards the present Alkali Act, we would object that, though successful, it is too limited in its application.

Secondly, the onus of carrying out its penal clauses rests on the inspector. We should have a noxious-vapour Act, applicable to every manufacture where injurious gases are thrown off. The duty of the inspector should be solely to inspect, and to publish the results of his inspection: the public should be the prosecutors.

Let us follow the working of such an Act. In every district, its inspector would from time to time publish a list of the works, together with the amounts of acid or other vapour escaping from them; this would be given either as the amount in 1000 cubic feet of the chimney-gases, or the actual amount by weight of that which escapes per month or per annum. The result of this to the manufacturers would be that they would anxiously consult the published list, nnd exercise a wholesome rivalry as to who should stand well in it. Moreover, these lists would form the basis for assessment of damages in case of claims made by the neighbouring farmers. A pecuniary stimulus would thus also be given. To the neighbouring farmer or landholder these lists would be invaluable; they would show him where to apply with the best chance of success for compensation for proved loss by noxious vapours, or enable him to apportion his claim among several works, in proportion to their places in the list and their relative distance from his land.

Thus, in place of the goading influence of a few isolated and sudden prosecutions, a gradual pressure onwards would be felt—a constant stimulus to improvement. All chemical manufacturers cannot be embraced in the provisions of an extended Alkali Act until for each separate noxious vapour a process of suppression can be described, and a limit for its working defined; but, with such an arrangement as is here proposed, all noxious vapours, without the task of enumeration, would be at once legislated for. If there are several manufacturers carrying on the same processes in the same district, and one of them, by special ingenuity, discovers some process by which a large portion of the acid-vapour he has hitherto sent away may be condensed, he improves his place in the *list*, and so enjoys immunity from actions for damage on the part of the farmers. The other manufacturers would obviously be compelled to follow him in the race of improvement. Thus all would be brought up to the rank of the foremost, and there would be a constant impulse to the manufacturer to reduce the noxious emanations from his works within the smallest possible amount.—*Quarterly Journal of Science.*

CHEMICAL TABLES ACCORDING TO THE THEORIES OF MODERN CHEMISTRY.*

By Prof. ALBERT R. LEEDS.

So long as chemistry was in a transition state between the theory of dualistic combination, the electro-chemical theory of Berzelius and his disciples (which reigned with an almost absolute sway during the first half of the present century), and the unitary theory evolved by Gerhardt, Laurent, Dumas, Hofmann, and other illustrious theorists, chemists might reasonably bear with patience the contradictions and perplexities arising from the unsettled condition of the science. In the opposing rush of contending opinions, the old and well-known landmarks had been swept away, the high-roads of thought had been blocked up by the wrecks of abandoned theories, and little else except the original soil—the facts themselves—remained, upon which the theories of modern chemistry might enter and take undisputed possession. The few who cling to their ancient beliefs have ceased to defend them, and only plead the inaptitude of old age, or the bias of early education, in defence of their loyalty.

But, now that the unitary theory has prevailed, it is intolerable that we should be compelled to reason upon and perform the operations of a chemical synthesis or analysis by the formulæ of the old, and compute its numerical results by the data of the new system. Still more so, that

* Communicated by Professor Morton. From advance-sheet of the *Journal of the Franklin Institute.*

we should calculate values for constituents, the bare existence of which has never been demonstrated. As, for example, that we should calculate, from the results of an analysis of felspar, its percentage of potash, soda, lime, magnesia, iron, and silica, when it has not been proven that any of these compounds exist as such in the felspar. To evaluate the potassium, sodium, calcium, magnesium, aluminum, iron, and silicon radicals, and then add the oxygen, sufficient to close the atomic group, is all that our present knowledge admits of.

To obviate these difficulties, the table given at the end of the present memoir was all that was originally conceived of. It was designed to give, in this table, the formulæ and molecular weights of the most important substances, and to adapt it to the ordinary calculus of synthetic and analytical chemistry. But when it became necessary, as a preliminary step in the construction of such a table, to select values for the atomic weights of the elements, a source of great perplexity presented itself. The values given in the most important general works upon chemistry were found, as will be seen by reference to Table II., to exhibit considerable discrepancies, and to differ, not only between wide limits, but also without apparent rule. There was no shorter way of solving these difficulties than to examine the sources from which these numbers for the atomic weights were originally drawn. This has been an arduous task, and has carried me far beyond the scope of the first intention. But the pleasure and instruction derived from the critical study of the classic literature of the subject, has more than repaid the outlay of time and labour.

First in order and importance is the chapter on the "Bestimmung der Atomgewichte der Grundstoffe," which is given by Berzelius in the third volume of the Leipsic edition of his "Lehrbuch der Chemie." His wonderful analytical skill, fertility of invention, close discrimination, and impartial judgment, inspire the chemist with grateful admiration for his great master. The numbers given by Berzelius are taken on the oxygen scale, O = 100. In the table of atomic weights, according to the original observers, I have computed from these numbers their corresponding values on the hydrogen scale, hydrogen being taken as 6·24, the number assigned to it by Berzelius. But in Table III., which I have adopted as a standard, the value of the hydrogen unit on the oxygen scale has been taken as 6·25, in accordance with Dumas; hence, when the atomic weights of Berzelius have been retained, their values have been re-calculated, on the supposition that the hydrogen unit taken on the oxygen scale is 6·25 This will explain the apparent discrepancies between Tables I. and III. Next in importance to the labours of Berzelius were those of Dumas, which will be found in the *Ann. de Chem.* [3], i., 5; viii., 189; and iv., 129. They were undertaken with the purpose of establishing the truth of Prout's law—that the atomic weights of all the elements are multiples by some whole number of that of hydrogen. The numbers which Dumas obtained compelled him to abandon the law of Prout as originally maintained, and induced him to promulgate it again in a modified form. He brought forward the theory that the elements might be divided into three groups; in the first of which he placed those elements whose atomic weights are multiples of the atomic weights of hydrogen; in the second, those whose atomic weights are multiples of 0·5, the atomic weight of hydrogen; in the third, those whose atomic weights are multiples of 0·25, the atomic weight of hydrogen. But, even then, some deviations from the experimental data was requisite to accommodate his observed to his theoretical atomic weights.

Later, a series of researches was undertaken by Stas, and published under the title of "Recherches sur les Rapports Reciproques des Poids Atomiques," in the *Bull. de l'Acad. R. de Belgique* [2], x. (No. 8), 1860. He re-determined the atomic weights of oxygen, chlorine, sulphur, potassium, sodium, silver, and lead with exceeding care, and exhausted the refinements of chemical art in the purification of his reagents, the variation of his methods, the accuracy of his weighings, and the verification of his results. The differences between the numbers attained by Stas, in a great number of trials for the atomic weight of each of the above-mentioned elements, is less than the differences between the observed atomic weight and the atomic weight which would be required to bring it into conformity with Prout's law. Stas naturally maintained that the atomic weights which he had obtained by unimpeachable experiments should be adopted in opposition to those supported only by theory. It has been said, in reply, that we must not expect to find in chemistry, any more than in botany and zoology, a law of proportion between parts verified in Nature with mathematical exactness, but only a more or less close approximation—a view certainly of great plausibility, and fortified by abundant analogy. At this point the discussion, for lack of proof more decisive on either side, at present rests.

(To be continued).

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

(Continued from p. 33).

Mauve, Magenta, and some of their Derivatives.

You will remember that in my last lecture we went over all the various steps between coal and colour. We saw how coal-tar was produced from coal; how coal-tar, naphtha, and benzol were separated from coal-tar; how nitrobenzol and aniline were made from benzol, and concluded with an account of the preparation of aniline purple, or mauve from aniline. We will now proceed to the study of some of the most remarkable properties of aniline purple.

This colouring matter is sometimes supplied to consumers in a pure and beautifully crystalline condition. This product is found to be a salt of a compound, chemically termed an organic base. This base has been called "mauveine;" it is composed exclusively of carbon, hydrogen, and nitrogen, in the folllowing proportions:—

$$C_{27}H_{24}N_4.$$

Mauveine, although the base of aniline purple, when in solution is not of a purple but of a dull violet shade, and in the solid state is a nearly black crystalline powder. The moment, however, mauveine is brought in contact with an acid so as to form a salt, its solution changes to a purple colour. This takes place even with that feeble acid carbonic. I have here a dilute solution of mauveine; you will observe the dull violet colour it possesses, but if my assistant only breathes through it a few moments the carbonic acid of his breath will combine with it, and it will acquire the ordinary colour of aniline purple.

Mauveine is a most powerful chemical body, and will easily decompose ammoniacal salts. This may be readily seen if some mauveine be heated with chloride of ammonium and a little water, when an abundance of ammonia gas will be evolved, which can be distinguished not only by its odour, but by the white fumes it produces with hydrochloric acid.

The salts of mauveine are beautifully crystalline, and possess a splended green metallic lustre. The crystallised commercial product consists of the acetate. Mauveine possesses one of the peculiar properties of indigo. Indigo, when treated with reducing agents, such as a mixture of sulphate of iron and lime, is rendered nearly colourless and soluble, but this colourless indigo, when subjected to the oxidising influence of the atmosphere, rapidly becomes blue again. I here refer to the indigo vat so much used by dyers. Mauveine, when treated in a similar manner,

* The Cantor lectures, delivered before the Society of Arts.

is also nearly decolourised, changing to a pale brownish yellow fluid, but the moment this is exposed to the air it assumes its original colour far more quickly than indigo. This remarkable fact may be strikingly illustrated by boiling an alcoholic solution of salt of mauveine with a few strips of zinc in a sealed tube from which the air has been previously removed. The dark purple solution will gradually lose its colour, and change to a very pale-yellowish brown shade.

I have a tube containing some aniline purple decolourised in this manner, and now if I open it, the air rushes in and the solution instantly assumes the ordinary purple colour.

Ordinary indigo is quite insoluble in water, and, therefore, its property of becoming soluble, as well as colourless, when treated with reducing agents, is of great practical value, as the dyer, by immersing his goods in this solution of indigo, and then exposing them to the oxidising influence of the air, gets the colouring matter firmly fixed in the fibre of his materials. But as the mauve is always soluble in water, this property has not been found of any practical value.

Aniline purple, when introduced as a dye, being the first colour of its kind, had to encounter many prejudices, and, on account of its peculiar nature, required the adoption of new or modified processes for its application. These difficulties, however, once overcome, its progress was very rapid. At first it was principally employed by the silk dyer and printer, its application to silk being comparatively easy, but it was not used by the calico-printer till a few years afterwards.

I distinctly remember, the first time I induced a calico-printer to make trials of this colour, that the only report I obtained was that it was too dear, and it was not until nearly two years afterwards, when French printers put aniline purple into their patterns, that it began to interest British printers.

It will be seen that to introduce a new coal-tar colour after the mauve was a comparatively simple matter. The difficulty in the manufacture of all the raw materials had been overcome, as well as the obstacles in the way of the practical applications of an aniline colour to the arts.

We will now turn our attention to a colouring matter which has often been confounded with aniline purple. I have designated it as "Runge's blue," as it was first observed by Runge. I have mentioned that Runge, when he first obtained aniline, termed it "kyanol," or blue oil, on account of the blue-coloured solution it gave with chloride of lime.

After discovering the mauve, I naturally made experiments with this coloured product of Runge's, to see if it contained aniline purple, but my experiments answered the inquiry in the negative. A few years afterwards, however, I was puzzled by finding that French manufacturers were beginning to produce aniline purple by the agency of chloride of lime and a salt of aniline; being much occupied at that time, I was unable to look carefully into the matter; and it was not until investigating these apparently opposite results a short time since that I was able to understand them. I will perform Runge's experiments, and for that purpose will take a solution of hydrochlorate of aniline, and add to it a very dilute solution of chloride of lime (taking care not to add too much). The solution is now changing, and getting slightly opaque; by daylight it has an appearance like indigo, but if I render it clear by the addition of alcohol, and place it before the magnesium lamp, it is seen to be of a brilliant colour, and nearly pure blue, quite unlike aniline purple.

I have lately succeeded in obtaining this blue product in the solid condition by treating a solution of hydrochlorate of aniline with a dilute solution of chloride of lime, and precipitating the resulting colouring matter with common salt; it is thus obtained in an impure condition, and may be collected upon a filter; by treatment with cold ether or benzol, a large quantity of brown impurities are separated, the colouring matter being left in the solid condition. This substance dissolves in alcohol, forming a nearly pure blue solution, and is capable of dyeing silk a blue or blue-violet colour.

An alcoholic solution of Runge's blue behaves with caustic potash quite differently to aniline purple, forming a brownish-red coloured solution instead of a violet. Therefore, there can no longer be any reason for confounding this body with aniline purple, it being entirely different, both in colour and chemical properties. But as this colouring matter is produced by oxidising hydrochlorate of aniline with chloride of lime, how is it that manufacturers have succeeded in preparing aniline purple with the same reagents? This question I find is very easy to answer: the manufacturer has gone a step further and boiled his product. Now, if I take a piece of silk dyed with Runge's blue, and, instead of boiling it, which would wet it, and make it difficult to manipulate, do that which is equivalent —steam it—a very remarkable change takes place—Runge's blue being changed into the mauve. So, here we have cleared up the mystery, and find that by the action of chloride of lime on hydrochlorate of aniline, we first get Runge's blue. and then, by heating this blue we change it into mauve. Runge's blue is a very unstable body, and of no practical value, its alcoholic solution changing into mauve in a day or two. This change takes place directly by boiling.

We must now pass on to another colouring matter, in name well-known to all of you, I mean magenta, also called roseine, fuchsine, aniline red, and various other names. The discovery of this body and its manufacture were strangely dependent upon the source which had been selected for the preparation of aniline for the mauve. Had the aniline contained in coal-tar, or the aniline obtained from indigo, been employed for the preparation of the mauve, instead of that prepared from commercial benzol, magenta and its train of coloured derivatives would, in all probability, have remained unknown to this present day, from the simple fact that magenta cannot be produced from pure aniline, a second body being also required.

You will observe, by reference to the table of coal-tar products, that next to benzol there is a substance named toluol, a substance having a boiling point not very much above that of benzol, On this account toluol is always contained in commercial benzol, and possesses most of its properties. With nitric acid it forms nitrotoluol, very similar to nitrobenzol; with iron and acetic acid it is converted into a base, toluidine, very similar to aniline, except that it is solid instead of liquid, when pure. Therefore, aniline prepared from commercial benzol always contains a little toluidine, and this is the second body requisite for the formation of magenta.

An apparatus for the fractional distillation of coal-tar naphtha has been devised, so that its constituents may be almost completely separated from each other, and thus pure benzol or pure toluol may be obtained.* Having obtained these hydrocarbons, pure aniline and pure toluidine may be prepared and then mixed in the most suitable proportions for manufacturing magenta. This process is not very generally employed, however, but the quality of the mixture of aniline and toluidine is determined by distillation, noting the quantities which come over at different temperatures. The necessity of toluidine as well as aniline for the production of magenta was discovered by Dr. Hofmann, who found that it could not be produced by perfectly pure aniline, nor perfectly pure toluidine, but that a mixture of these two bases yielded it in quantity. Magenta was apparently first observed by Natanson, in 1856, when examining the action of chloride of ethylene on aniline, and afterwards by Dr. Hofmann, in 1858, when studying the action of tetrachloride of carbon on aniline, but industrially the discovery of magenta was made by M. Virguin, of Lyons, in 1859, three years after the mauve. M. Virguin's process con-

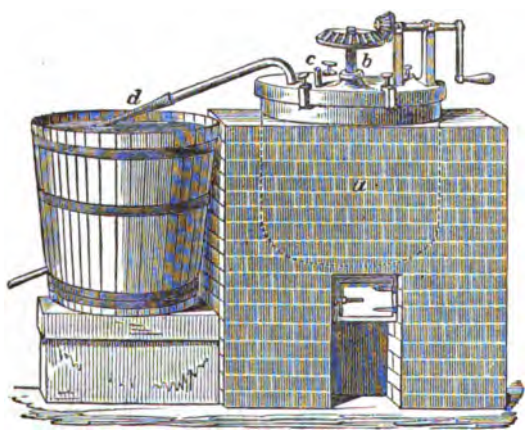
* See "Clarke's Specification," June 5th, 1863, No. 1405.

sisted in treating commercial aniline with a fuming liquid, called tetrachloride of tin, and was first carried out by Messrs. Renard Brothers, of Lyons. Since 1859, patents have been taken out for the production of this colouring matter with aniline, and almost all chemicals known, whether capable or incapable of forming magenta. I may mention one process which was extensively employed, and is still used to some extent in Germany, and that is the method of making magenta with commercial aniline and nitrate of mercury. With care this process works very well, and the colouring matter produced is of good quality. When first introduced, magenta prepared by this method was not purified, but sent into the market in a crude form, so that before using it the dyer had to extract it with water. In the preparation of magenta by this process, all the mercury of the nitrate of mercury employed is recovered in the metallic state, but although this process may possess some advantages, yet the use of mercury salts is most undesirable on account of their fearfully deleterious influence upon the workmen.

The process, which has almost superseded all others, is that for the use of arsenic acid, as proposed by Medlock, and patented by him in January, 1860. This patent is notorious for the amount of litigation it has caused, showing that a patentee should not only be a discoverer but a lawyer, and even more, and able to discover precisely how much to claim and disclaim in his patent, and also to arrange his specification so that the intellects of the whole world may not be able to discover a single flaw in his description; and it is a common misfortune to inventors who wish to thoroughly protect themselves to find that they have claimed too much.

The manufacture of magenta, as now carried on, is a very simple process; it is conducted in an apparatus somewhat similar to that represented by fig. 5.

FIG. 5.



This apparatus consists of a large iron pot, *a*, about 4ft. diameter, set in a furnace of brick-work; it is provided with a stirrer, *b*, worked by hand. All the gearing for this stirrer is fixed to the lid, so that stirrer, lid, and all may be lifted away by means of a crane or other suitable apparatus. There is also a bent tube fixed into the lid, and connected to a condensing worm, *d*, by means of a joint, which can be made or broken at pleasure. In preparing magenta, a quantity of aniline, containing about 25 per cent of toluidine, and a nearly-saturated solution of arsenic acid, is introduced into this apparatus, and well mixed by working the stirrer; the proportions of the materials are in about the ratio of 1 of aniline to 1·5 of a 75 per cent solution of arsenic acid. When these are well mixed the fire is lighted. After the product has been heated for some time water begins to distil over, then aniline and water, and lastly nearly pure aniline.

This operation requires some hours for completion, and this is determined by inserting an iron rod, from time to time, and drawing out a portion of the product for examination, as well as by the amount of aniline which distils over. When the heating has been completed, a steam-pipe is introduced into the apparatus, and steam blown through the fused mass; by this means an additional quantity of aniline is separated. The lid is then liberated and lifted, with the stirrer, from the apparatus, and the product left to cool before it is removed. A more elaborate and larger apparatus is sometimes used, which possesses considerable advantages over the smaller one. The iron pot is larger, and is provided with an outlet at the side, which is closed during the operation, and the shaft of the stirrer is hollow (as in the aniline apparatus described last lecture, fig. 4), and worked by steam. When the operation of heating is concluded, steam is blown down the shaft, and after the addition of water the product is boiled and run out of the outlet in the side of the pot; by this arrangement it is unnecessary to disconnect the lid of the apparatus, and the product does not require to be removed by mechanical means, as with the apparatus previously described.

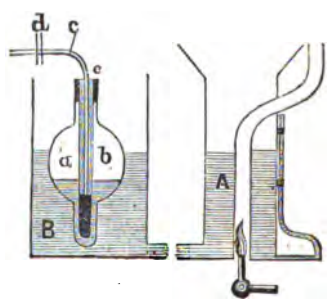
The crude product obtained by heating aniline and arsenic acid, is next transferred to vats, boiled with water, and filtered. Common salt is then added, which precipitates the crude magenta; this is collected and dissolved in boiling water, again filtered, and the solution, on cooling, deposits the colouring matter in the crystalline condition. This, when re-crystallised, constitutes commercial magenta.

(To be continued.)

ON A CONTINUOUS WATER-BATH.*

AN apparatus of this kind, fully meeting all demands upon it, was some time since designed by Prof. Bunsen, who has abundantly stocked his laboratory with these, now, indispensables, which are only excelled for convenience and in saving of time and labour by the well-known filtering-pump. The want of just such a contrivance as this will have been felt by every chemist.

The method he adopts is to maintain a constant water level in a reservoir, which has free communication with one or with any number of the baths. In the accompanying



cut, A is the bath in cross section, composed of an outer copper cylinder, through the centre of which runs a small tube of the same material, emerging at the upper end of the cylinder beneath a large flue. In the lower part of the cylinder an ordinary burner is permanently fixed, which heats the bath, and the products of its combustion are thus safely carried off. The upper part of the cylinder is fitted to receive a large funnel, in which the capsules, &c., of various sizes, containing the material to be evaporated are placed, the watery vapour escaping likewise

* Communicated by Dr. W. H. Wahl. From advance sheets of the *Journal of the Franklin Institute.*

under the flue. The lower end of the cylinder is furnished with an outlet upon each side,—one connecting with an open glass tube attached to its side, to indicate the level of the water within, and the other connecting with the reservoir, B.

This, the essential portion of the contrivance (shown in cross section in cut), consists of an outer glass vessel, B, containing water, in which floats the bulbed tube, *a*; within this again stands a tube, *b*, open above like *a*, and containing some mercury. A tightly fitting caoutchouc ring, between the two, holds *b* in its place, and prevents any communication with *a*; and lastly, within *b* is a small tube, *c*, connecting with the water main, and dipping somewhat into the mercury of tube *b*. The tube *c* is held immovable in its place by clamps indicated at *d*, and does not partake of the up-and-down motion of the tubes *a* and *b*, about to be mentioned.

The various parts having now been given in detail, it only remains to consider their operation.

The water in A and B, being in communicating vessels, is at the same level in both; but the instant the flame lowers the level in A, by vapourising its contents, it is restored by the influx of water from B. The loss of water in B would leave less to buoy up the float, which consequently sinks. In the sinking of the float, however, the opening of the tube *c*, (which is immovable), is left under the pressure of a smaller column of mercury, and when the sinking has reached a certain point, the pressure of water from the main becomes greater than the opposing pressure of the mercury. Water flows from it, bubbles through the metal, fills the tube *b*, and overflows at *e* into the reservoir B. The increase of water in this gives increased buoyancy to the float; it rises, the opening of the tube *c* is plunged deeper into the mercury, the increasing pressure of which prevents further flow from the water main. The original level has now been regained, and equilibrium restored; but only to be destroyed again, by the continued action of the lamp, vapourising the water in A, which brings about the indefinite repetition of the process just described in detail.

The height to which it is desired that the water, in the bath shall stand, can be regulated in various ways; either by loosening the clamps at *d*, and closing them again, after giving to the opening of tube *c* a permanently higher or lower position than it had previously occupied, or by adding to or taking from the mercury in *b*, &c.

It need scarcely be stated that one reservoir can be connected with quite a number of baths, by carrying a water-pipe behind them and allowing a separate tube to lead to each bath. This contrivance is, as its name indicates, entirely automatic. Material can be left upon it over night; or for days together, without requiring the constant attention, replenishing of water, &c., which make the use of the old, time-honoured instrument so often troublesome and delaying.

NOTICES OF BOOKS.

The Manual of Colours and Dye Wares: their Properties, Applications, Valuation, Impurities, and Sophistications. For the use of Dyers, Printers, Drysalters, Brokers, &c. By J. W. SLATER, Author of "The Handbook of Chemical Analysis for Practical Men." London: Lockwood and Co. 217 pp.

THE author of this little volume states that the object of this manual is to furnish, in a brief space, an account of the chemical products and natural wares used in dyeing, printing, and the accessory arts—their properties, their applications, the means of ascertaining their respective values, and of detecting the impurities which may be present.

We have, therefore, a book professing to give accurate information upon the subjects the author treats of, in alphabetical order, beginning with acetate of iron (so-called black liquor, or pyrolignite of iron), and ending with sulphate of zinc. It is perfectly clear that it is quite impossible to review *seriatim* each, or even many, of the articles contained in this work; but, in order to judge of its contents fairly and in an unbiassed manner, we shall, at random, take some instances, in order to see how far the author has succeeded in his plans.

At page 41, we read—"*Carmine.*—The finest portion of the colouring matters of cochineal, freed, as far as possible, from impurities, and combined with alumina." Perfectly pure carmine is readily soluble in ammonia, and does not contain alumina at all. The author forgets that the alum used in the preparation of carmine from cochineal serves no other purpose than that of hastening the settling down of the colouring matter, "carmine," which is *not combined*, as comparatively recent researches have taught, with alumina, and does not contain a trace even of that base. The compound of the colouring matter of cochineal with alumina is known as carmine lake. Of "*Chinese Green*" (*Lo-kao*), we read (page 44)—"A simple green colour, whose nature and origin are still involved in obscurity." The author should have taken more care to study this matter. The nature and origin of this substance are known accurately; but, from the host of information on this subject, which alone would fill more than two numbers of our paper, we need only state here that it is the product of the *Rhamnus utilis*, called, in Chinese language, *hong-pi-lo-chow*; and not only is the preparation of the *lo-kao* well known, but it is even extracted from European plants of the *Rhamnus* tribe. Speaking of "*Madder*" (page 107), the author says—"The Dutch and Alsatian madders, which are in great request for certain shades, but which do not equal the Avignon qualities, are"—&c. Now this peremptory statement that these madders do not equal the Avignon qualities, is directly at variance with the experience of all those who employ these substances on the large scale, and are well acquainted with their properties, degree of maturity, and proper mode of application; we can, moreover, say that a large number of sound, practical men, in France, regret that, in order to favour the Avignon and *Palud* (not *Palus*, as written by the author) growers of madder-root, the use of Zeeland madder is almost prohibited there. Regarding this, no less an authority than M. Girardin (whose views in this respect were fully endorsed by the late celebrated Mr. Walter Crum) says that, when applied at its maximum of maturity, Zeeland madder is, in every respect, superior to all others, and the Alsatian is not much behind it. Speaking of "*Persian berries*," the author says (page 142)—"Some of the berries are large and greenish, whilst others are smaller, brown and wrinkled, the colouring principles in these two kinds being distinct." There are met with in commerce no less than seven different kinds of these berries, the produce of different countries, as well as of different varieties of the same tribe of shrubs; but it is not correct to say that the colouring principles differ according to the varieties of the berries. The coloured glucosides contained in these berries do not vary, unless the berries are too old and turning black, when the colouring principles have undergone an alteration, as has been proved by the labours of MM. Persoz, Gellaty, Ortlieb, Schützenberger, and Bertèche. The statement, therefore, that, as regards the berries, the colour of the large or greenish should be known as *rhamnein* or chrysorhamnine is not correct, the author evidently having neglected to consult the papers of the gentlemen just named on this subject. Of "*Safflower*," it is stated (at page 152) that it contains *two* colouring matters—a yellow, which is worthless, and a red, which is very fine; it is also said (page 153) that the yellow matter is soluble in cold water. The fact is that safflower contains three colouring matters—viz., one yellow, soluble in pure and acidulated water; another yellow matter, only soluble in an alkaline liquid; and,

lastly, the red colouring matter, called carthamic acid or carthamine.

We need not multiply such instances; a thorough and unprejudiced perusal of this book shows it has been written without sufficient care, and without the use of such books as the author speaks of in a somewhat contemptuous tone in his preface. The work certainly contains some good matter, but the whole *ensemble* has been evidently hurriedly compiled and is very ill digested. Such a work might be made to convey precise and correct information; but the present volume, we regret to say, does not do this. As to the purely chemical part, we abstain, purposely, from saying more than this—that the existence of really good books treating on qualitative, as well as quantitative, chemical analysis, renders superfluous what the author has published in these pages. The typographical execution of the book is good, and its index very complete.

Report on the Gas Nuisance in New York. By C. F. CHANDLER, Ph.D., Professor of Analytical and Applied Chemistry, School of Mines, Columbia College. Extract from the Fourth Annual Report of the Metropolitan (viz., Empire City, New York) Board of Health. New York: D. Appleton and Co. 1870.

WE are indebted to Dr. Chandler for having forwarded a copy of this very interesting and elaborate report.

The nuisance, known as gas nuisance, which for a considerable period of time must have been intolerable to those districts of the City of New York situated near the localities from which it arose, is described by the author as having been caused by the exposure to air of the foul lime used in the so-called dry lime process of gas-purification by some of gas companies which supply the illuminating-gas to the city alluded to; and, in the report before us, the Metropolitan Company is the chief delinquent. This company, it appears, did not take the least heed of the complaints made; and, as a consequence, the Metropolitan (New York) Board of Health took vigorous steps to enforce the order made by it, whereby all the gas companies of the said city were compelled so to conduct their operations as to prevent injury to life and health. The Metropolitan Gas Company, instead of complying, commenced a litigation with the Board; and, as a consequence, there was commenced, before magistrates, an inquiry into the whole affair, and witnesses were heard on oath, and the whole question of gas-purification thoroughly gone into. Among the well-known scientific gentlemen summoned to appear and give evidence were—Dr. Chandler, as chemist to the Board of Health before referred to; Prof. B. Silliman, for the Gas Company; Prof. Wurtz, for the same. Prof. Silliman differed in opinion from Dr. Chandler as to the expediency of introducing the so-called iron purification-process, instead of lime; but he stated clearly and unequivocally that the process of purification as conducted by the Metropolitan Company was a nuisance which, by using simple precautions, could be avoided. After a great deal of delay, and the making of excuses of all kinds, the gas company referred to (having spent, in expert fees, counsel fees, &c., some 10,000 dollars) have complied with the order of the Board of Health, and introduced a system of purification which answers the purpose.

The Report before us (about 112 pages in small type, chiefly containing the full evidence given before the Court at New York) contains, as may be imagined, a very large amount of valuable scientific and practical matter relating to the purification of gas and gas manufacture in general; while the very compact and ably-written paper on the methods of gas-purification from Dr. Chandler's pen greatly contributes to make this work an excellent *exposé* of the subject treated of, as carried out in practice.

CORRESPONDENCE.

THE SPECTROSCOPE APPLIED TO THE BESSEMER PROCESS.

To the Editor of the Chemical News.

SIR,—In the third volume of Crookes and Röhrig's "Metallurgy" (which has just come into my hands), I find, on page 721, that, although the authors give me the credit of first proposing (in 1863) to use the spectroscope in the Bessemer process, they state that the actual practical application is due to Professor Lielegg, in 1868.

As it seems to me, the merit of the practical application is rather due to the Styrian iron and steel makers, who adopted, as valuable, the results of Lielegg's experiments—results which are, in fact, identical with those which I made known five years before. I then showed, beyond doubt, that the exact point of decarbonisation can be accurately arrived at by spectrum observations; and I frequently ascertained that this point exactly agreed with that at which the blast is turned off. The English steel-makers were shown in 1863 exactly that which the Styrian makers were taught in 1868. The English appear to think that the point can be detected by the naked eye with a sufficient degree of exactitude; the Styrians prefer to use the spectroscope.—I am, &c.,

HENRY E. ROSCOE.

Owen's College,
Manchester, July 13th, 1870.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO AERONAUTICS.

To the Editor of the Chemical News.

SIR,—As compiler of the "Abridgments of Specifications relating to Aëronautics," I have to express my best thanks for the very favourable critique upon that little work that appeared in the CHEMICAL NEWS (vol. xxii., p. 19).

As the gentlemen that are deputed by the Commissioners of Patents to compile certain series of Abridgments are extraneous to the Patent Office, as they are chosen for their special knowledge of the subjects they undertake, and as their names are annually published in the Commissioners' Report, I was surprised that no recognition of my connection with that work appeared in your notice. I may perhaps be allowed to remark that the publication of the name of an abridger is possibly an act of justice to the public, as well as to himself. I therefore would suggest that you state my connection with that work, and with the introduction thereto, in any way that you may think best.—I am, &c.,

W. H. WALENN.

74, Brecknock Road, N.
July 13th, 1870.

[The compiler's name having only been given to us in writing, we did not feel at liberty to publish it when reviewing the work..—*Ed.* C. N.]

RUBIDIUM AND CÆSIUM.

To the Editor of the Chemical News.

SIR,—I have found that, so far as my researches on rubidium and cæsium in sea-water and its products depend upon spectroscopic reactions, they are unreliable. In sea-weed, as stated, I have found, by analytical methods, these alkalies; and, so far, the work can receive no further confirmation than it has already had. But, as respects the oxalate of calcium thrown down from sea-water, and the spectroscopic reactions of sea-shells and of limestone, I now believe the lines attributed to rubidium and cæsium

to be due to calcium and to strontium respectively. It is curious, and may, perhaps, partly excuse me, that the trace of strontium, at the most, that can be supposed to be contained in sea-water and in shells should, when so combined, give *only* the lime belonging to strontium marked *delta* in the maps, and therefore the fourth in order of intensity; but my further experiments leave me no room to doubt but it is so. This line, in my instrument, is not distinguishable from the blue line given by an impure compound of cæsium, no more than is the blue calcium line from the most characteristic of the rubidium lines. So far as I trusted to the spectroscope alone, so far I was deceived; but what was done independently of the spectroscope remains true.—I am, &c.,

E. SONSTADT.

Ramsey, Isle of Man,
July 18th, 1870.

MR. BESWICK AND SWEDENBORG.

To the Editor of the Chemical News.

SIR,—Mr. Beswick leads us to a mare's nest. That a certain quantity of dry salt disappears in water without increasing the bulk of the liquid is a very ancient observation. How could a fact at once so curious and obvious escape even a housewife's eye? The familiar anecdote will be remembered of King Charles II. testing the wits of a party of philosophers by requiring of them the reason why a fish immersed in a bucket full of water did not cause the water to overflow. Forthwith, several began to devise explanations, until one, shrewder than his fellows, suggested whether, indeed, a fish behaved like salt under the circumstances!

Swedenborg's assertion that "the saline particle fits the convexity of the watery particles," and "is constantly attended by six aqueous globules," may be true, or may not. The chances are many against its truth; for such wanton fancies are rarely, if ever, verified by experience. At the time Swedenborg wrote (1721), mechanical or geometrical chemistry was in high vogue, and his conjectures would be regarded as perfectly legitimate. Lemery, a *savant* of great celebrity, contributed, in 1711, an elaborate paper to the Memoirs of the French Academy, wherein he argued that a fluid which dissolves a solid does so by pointed particles, which enter into pores of corresponding shapes and sizes in the solid. Thus nitric acid dissolves iron and copper, but not gold; because they have wide and numerous pores, and gold has not. How men had patience for such soothsaying is almost inconceivable at this day. Possibly we are quite as foolish in other ways, as posterity will in due course discover.

Dalton extended the observation of the behaviour of chloride of sodium in water over the whole series of salts with which he was acquainted. His assertion that the initial fact of his investigation was new to him is surprising, and that in its scope, as completed by him, it was "the greatest discovery that he knew of, next to the atomic theory," scarcely less so. We must remember, however, that Dalton's general information was not extensive. He was content to be ignorant of many things, that he might know a few thoroughly. He used to say he could carry all his books on his back. Moreover, in 1840, his well-worn brain was giving way, and he was writing under the exasperation of the rejection of his papers by the Royal Society.

No man holds Swedenborg's merits and memory in deeper reverence than I do, but for that reason fictitious claims advanced in his name affect me with shame and dismay. They only serve to perpetuate the prejudices against him, which I sorrowfully find to be almost insuperable.—I am, &c.

WILLIAM WHITE.

30, Thurlow Road, Hampstead,
July 18th, 1870.

MISCELLANEOUS.

The Hall Testimonial.—On Thursday evening, the 14th inst., a large attendance of former pupils and friends of Mr. Thomas Hall, B.A., F.C.S., assembled at the City of London School, for the purpose of presenting that gentleman with a handsome testimonial, in recognition of his past services as Lecturer on Chemistry and Experimental Physics in that establishment. For the space of twenty-one years (since March, 1847) Mr. Hall had held this post, and successfully directed the studies of a large number of pupils, some of whom have, in consequence, acquired great distinction in the pursuit of science; and his retirement from the school was deemed a fitting occasion for presenting him with a testimonial, subscribed for last year, but only now handed to him, by reason of his compulsory absence from this country on account of ill health. The testimonial took the form of a handsome silver casket and purse of 200 guineas, and was presented by the late head master, the Rev. G. F. W. Mortimer, D.D., Canon of St. Paul's, who took occasion to testify to the successful results of Mr. Hall's teaching, and referred to a recent instance in which he had the satisfaction of presiding, at Barnard Castle, when as many as forty-eight prizes and certificates were bestowed by the Department of Science and Art on the pupils of a gentleman who was himself instructed by Mr. Hall at the City of London School. After Mr. Hall had replied, the present head master (Rev. Edwin Abbot, M.A.), Mr. W. H. Perkin, Mr. J. Spiller, Mr. E. Ryder Cook (Treasurer), and the Hon. Secretary, Mr. J. T. Brown, spoke in complimentary terms on the occasion, and the meeting concluded with a vote of thanks to the Rev. Chairman.

An Improved Method of Producing White Pigments from Lead.—(Letters Patent to J. G. Dale and E. Milner, of Warrington.)—This invention relates to an improved method of manufacturing white-lead, "carbonate of lead," by the action of the soluble acid carbonates of the alkalies on litharge, hydrated oxides of lead, or insoluble basic salts of lead. The patentees propose to carry out their invention in two ways, and when soda is the substance chosen, they proceed—(1) By mixing litharge, hydrated oxides of lead, or insoluble basic salts of lead, with an equivalent of bicarbonate of soda, together with sufficient water to form a stiffish paste. This mixture is ground in a suitable mill, small quantities of water being from time to time added as may be found requisite until the change of the lead bodies into carbonates is complete. The paste is now well washed with water, and the supernatant liquid which contains monocarbonate of soda is separated from the white-lead by filtration, and boiled down to dryness and disposed of as soda-ash; or it may be crystallised; or may be again converted into bicarbonate of soda, by treatment with carbonic acid, and used to convert further quantities of lead oxides, or insoluble basic salts of lead, into carbonates. Instead of grinding, the lead oxides, or insoluble basic salts of lead in a fine state of division, may simply be mixed with bicarbonate of soda and water and left to themselves, when the conversion into carbonates goes on in the same manner, only much more slowly. (2) They mix litharge, hydrated oxides of lead, or basic salts of lead, with caustic soda, monocarbonate of soda, or acid carbonates of soda, and sufficient water to form a stiffish paste. The mixture is now introduced into a suitable closed mill, and during the grinding a stream of carbonic acid gas is passed into it. After conversion of the lead bodies into carbonates, they are washed with water, and the supernatant liquid treated as before described. In carrying out their process by this secondly-described method, the patentees do not bind themselves to any particular proportion of lead oxides and soda, but equivalents of each answer very well. The quantity of the soda salts may, however, be reduced with advantage if found desirable. Grinding may also be dispensed with, by mixing the lead oxides or insoluble basic

salts of lead in a fine state of division with the caustic soda, monocarbonate or acid carbonates of soda, as described, and exposing the mixture in a suitable room to the action of carbonic acid. Artificial heat accelerates the conversion, both in the first and secondly-described operations, but is not essential to their success. The patentees claim the manufacture of carbonate of lead by the action of acid carbonates of the alkalies on litharge, hydrated oxides of lead, and insoluble basic salts of lead, either by direct addition, as described in their first part, or indirectly by the mixture of the lead oxides with the caustic alkalies, or their monocarbonate or acid salts, and their conversion into bicarbonates during the time they are in contact with the litharge, hydrated oxides, or insoluble basic salts of lead.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, July 11, 1870.

This number only contains the record of the frequently-postponed Annual General Public Meeting of the Academy, a meeting devoted to the distribution of the prizes to the authors of the different memoirs and essays written in reply to various questions in science, and found worthy, after careful scrutiny, of the honours the Academy is entitled to bestow. This number also contains the questions for which prizes are proposed to be given in the three ensuing years. From these various items, we abstract those which relate to physico-chemical sciences; in the first place—

Annual Trémont Prize, worth 1100 francs, is given to M. Le Roux, in order further to assist him to continue his researches on thermo-electric currents, and the determination of the indices of refraction of such bodies as do not become volatilised, unless at a very high temperature, such as mercury, sulphur, arsenic, sodium.

The Poncelet Prize (to be given to the author of the best work published on purely mathematical or applied science within the last ten years) is given to Dr. J. R. Mayer, at Heilbron, for his book on "Die Mechanic der Wärme" (The Mechanical Theory of Heat).

Medals, of the value of 3000 and 2000 francs each, are given to MM. Legros and M. Onimus and M. Cyon, for their important researches on the application of electricity to therapeutics.

Prix Des Arts Insalubres.—(1) To M. Pimont, for the invention of a peculiar kind of cement, a plastic material for covering steam boilers and apparatus wherein steam circulates, thereby to prevent the loss of heat by radiation; (2) to M. Charrière, for apparatus for saving life in cases of fire.

The Cuvier Prize is given to M. Ehrenberg, at Berlin.

The Jecker Prize is given, by a unanimity of votes, to Dr. Friedel, for his researches on organic silicium compounds.

The Montyon Prize is given to M. Arson, for his excellent researches on the flow of gas through great length of pipes.

Among the subjects for which prizes will be given, we notice—Researches to be made on the elasticity of crystallised bodies; on the theory of the rays of the spectrum; for the best work on organic chemistry.

It is usual at this meeting for one of the perpetual secretaries to read an eulogising biography on one of the lately deceased members of the Academy. This year, M. Dumas read such a biography of Theophile-Jules Pelouze, born at Valogne on the 26th of February, 1807. The deceased, a celebrated chemist, was Professor at the Ecole Polytechnique and the Collége de France, President of the Mint Committee, a Member of Council of the Manufactory at Saint Gobain (glass and porcelain works), a Member of the General Municipal Council of Paris, and especially one of the most indefatigable labourers in the wide territory of physico-chemical sciences. Among the large series of his labours, we only allude, in a few words, to his extensive researches on beet-root and the manufacture of sugar therefrom; his researches on hydrocyanic acid, formiate of ammonia, and prussic ether; on oenanthic ether; on gun-cotton and xyloidine; on fermentation; on the manufacture of glass, and improvements in its composition; on lactic acid and glycerine. The eminent speaker concludes his lengthy discourse with the following words:—"For forty years, M. Pelouze has been one of the foremost representatives of high science in France; his classical researches and discoveries, and the part taken by him in the reconstruction of organic chemistry, assign to him the rank, which will never be contested, of being one of its most eminent founders. The deceased *savant* was a member of nearly all learned Societies and Institutions of the world.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 9, 1870.

This number contains the following original papers and memoirs:—

Conversion of Organic Iodides into Bromides.—A. Oppenheim.—The chief point of interest in this paper is that, according to the author's experiments, bibromide of copper, a salt readilly and largely soluble in alcohol, is the best and most suitable material to bring about the conversion alluded to. When an alcoholic solution of this bromide is mixed with iodide of allyl, there is formed proto-iodide of copper and brom-allyl—

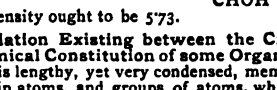
$$2CuBr_2+2C_3H_5I=2C_3H_5Br+Cu_2I_2+Br_2.$$

Iodide of amyl is readily converted into the bromide of allyl, when left for a few hours in contact, at 110°, with an aqueous solution of the bromide of copper.

On Chloral.—C. A. Martius and P. Mendelssohn-Bartholdy.—When equal equivalents of chloral and anhydrous ethylic, methylic, butylic, and amylic alcohol, or even mercaptan, are mixed together, chemical combination of these substances takes place, heat is set free, and the result is the formation of solid compounds, which may be viewed as intermediate trichloracetals. The ethyl combination boils at 115°—116°, solidifies at 40°; sp. gr., 1·143; soluble in cold water, but far more readily in ether, alcohol, acetic ether, and petroleum essence. The methyl compound boils at 98°. The amyl compound boils at 143°, is solid at 25°; sp. gr., 1·234; is not perceptibly soluble in water, but readily in alcohol and ether, from which solutions it is obtainable in crystalline state.

Chemical Nature of the Hydrate of Chloral.—V. Meyer.—The author says—When the constitution of the hydrate of chloral is expressed by—

it is one of those very rare exceptions to the rule that 2(OH) groups cannot be bound up with the same atom of carbon without producing, at once, an anhydride. The author's researches, as further related in this lengthy paper, are mainly undertaken with the view of establishing the true constitution of the hydrate of chloral, and for this purpose a series of complicated experiments have been made; but the chief result is that the hydrate of chloral is to be viewed as a molecular compound, which, in the state of vapour, consists of a mixture of aqueous vapour and vapour of chloral. The vapour density is 2·86; but, according to the formula—



the density ought to be 5·73.

Relation Existing between the Crystalline Shape and the Chemical Constitution of some Organic Compounds.—P. Groth.—This lengthy, yet very condensed, memoir sets forth that there are certain atoms, and groups of atoms, which are not, as regards their crystalline form, perceptibly affected by substitution of H for other atoms of elements; so that the original crystalline form remains, in the chief, undisturbed.

Some New Reactions of Phenol.—R. Lex.—The author says—Perfectly pure nitric acid (free from any of the lower products of the oxidation of nitrogen) does not, when diluted, act upon an aqueous solution of phenol; while such a solution mixed with a nitrite, and next acidified, yields, even when very dilute, a yellow colouration. If, to this solution, an excess of soda is added, a brownish colouration ensues, which is turned into a deep blue by the action of certain reducing substances—as, for instance, sugar, aluminium, zinc. The blue colour thus produced is exceedingly sensitive to the action of acids, carbonic not excepted, which cause the colour to become red; and the colouring matter thus produced is soluble in alcohol and ether. The pure nitro-derivatives of phenol do not produce this phenomenon, which, the author says, is due to the reduction of a peculiar amide body ensuing from the peculiar nitro compound of phenol produced as above alluded to.

Composition of the so-called Wootz, or Indian Steel.—Dr. C. Rammelsberg.—After referring, in a few words, to the ancient methods of procuring iron and steel, and stating that wootz is essentially a cast-steel, the author refers, first, to the analysis of the Indian steel made, in 1819, by the late Messrs. Faraday and Stodart, who stated that the peculiar qualities of this steel were due to silicium and aluminium; next, to the analysis of the same metal (of indisputably-genuine origin) made by Dr. Karsten and Dr. Henry, who did not find aluminium at all. The author analysed a portion of a steel bar (Indian steel, certificated for being genuine by the late East Indian Company), and deposited in the Museum of the High Polytechnic School at Berlin; the sp. gr. was found to be 7·822. The author did not find even a trace of aluminium; and, leaving iron aside, the following substances

were found in quantities, per cent:—Carbon, 0·867; silicium, 0·136; phosphorus, 0·009; sulphur, 0·002.

The Hydrates of Platinic Acid and Platinate of Barium.—H. Topsöe.—The author first refers, at length, to the researches of Drs. Doebereiner, Wittstein, Fremy, and others, on this subject; and next states that the hydrate of platinic acid, air-dried, is a yellowish white powder, readily soluble in solutions of soda and dilute acids, even acetic acid. Heated to 100°, it loses water and becomes iron-rust coloured. Formula, PtO_3+4H_2O. The acid contains 64·49 per cent of platinum. Platinate of baryta, $BaPtO_3+4H_2O$, is, when prepared with excess of baryta, a crystalline compound, containing 43·44 per cent of platinum and 33·67 per cent of baryta.

Action of Chloride of Phosphorus upon Pyruvic Acid.—E. Klimenko.—The author obtained, by this reaction, first, a liquid, boiling at 160°; sp. gr. at 0°, 1·2493; formula, $C_3H_3Cl_2O_2$. This substance, on being treated with dilute ammonia, yields a solid body, soluble in alcohol, and consisting of $C_3H_2Cl_3NO$. The author's investigations on this subject are not yet quite finished.

Polymeric Modifications of Aldehyde.—A. Kekulé and Th. Zincke.—The author's lengthy paper treats on paraldehyde and methaldehyde.

Nitrobenzyl-Cyanide and Amidided Benzyl-Cyanide.—E. Czumpelik.

Some Derivatives of Cuminic Acid.—E. Czumpelik.

Contribution to the History of α Cymol.—E. Czumpelik.—The length of these three papers, and the fact that the extensive series of lengthy formulæ, absolutely required for the proper understanding of the contents, would occupy too much space, forbids anything else than simply the quotation of the titles.

Action of Pentachloride of Phosphorus upon Hyposulphite of Lead.—J. Y. Buchanan.—The author undertook a series of experiments with the view to elucidate the constitution of hyposulphurous acid, but did not quite succeed; he states, however, that hyposulphurous acid cannot be viewed as a sulphuric acid, the hydroxyl of which has been replaced by hydrosulphoxyl.

Contribution to our Knowledge of some kinds of Sugar (Glucose, Cane Sugar, Levulose, Sorbine, and Phloroglucine).—H. Hlasiwetz and J. Haberman.

Evolution of Heat Ensuing on Mixing Water and Sulphuric Acid.—J. Thomsen.

Revue des Cours Scientifiques de la France et de l'Etranger, June 18, 1870.

This number does not contain any papers or memoirs relating to chemistry, but contains a remarkable paper on—

Vital Power.—Dr. Poelman.—The author states that, in addition to being subjected to the ordinary chemico-physical and mechanical forces, the living body of man is subject to a force which cannot be properly defined, but which supersedes the others, and may be called *intelligence fonctionnelle*.

June 25, 1870.

This number contains a very lengthy report, by Dr. Kékule, on the—

Labours of the German Chemists in the Past Year.—This paper was read at the meeting of German philosophers and medical men at Insprück, September, last year. The meeting this year will be at Rostock (Mecklenburg-Schwerin).

Spectroscopical Analysis of Blood.—Dr. C. Bernard.—A subdivision of the author's very lengthy and exhaustive lecture on asphyxia by the vapour from incandescent charcoal. This paper is illustrated with woodcuts.

July 2, 1870.

This number contains—

On the Bottom of the Atlantic Ocean.—L. Agassiz.—A lecture, divided into the following sections:—The animal life in the depths of the Gulf Stream; geological antiquity of the existing continents; origin of erratic blocks and loose materials; geology of the bed of the Gulf Stream; madreporic formation of the Gulf of Mexico; submarine and sub-terrestrial basins; the age of the Gulf Stream; limits of the fauna of the Gulf Stream; embryonic evolution of coral, compared with its classification; geological succession, and the depth of its ordinary habitation.

Isomerism (Allotropy) of the Elements.—Prof. Berthelot.—A lecture, treating on sulphur in all its various phases, viz.:—As octahedric, prismatic, amorphous soluble, amorphous insoluble; soft, oily but soluble, oily but insoluble, amorphous insoluble, as obtained from hyposulphites; the absorption of heat by the solution of octahedric sulphur; heat absorbed by the fusion of octahedric sulphur; conversion of octahedric into insoluble sulphur; capability of the different sulphurs of forming compounds; combination preceded by a change of the isomeric state; relation existing between the different states of sulphur and the nature of its compounds; on phosphorus.

We regret that the length of these lectures forbids us to do more than quote the leading points thereof.

July 9, 1870.

This number contains no papers directly relating to chemistry, but we meet here with the concluding lecture of the lengthy series given by Professor C. Bernard, on the—

Asphyxia by Charcoal Vapour.—This portion being divided into the following sections:—Elimination of the oxide of carbon; treatment of the poisoning produced by oxide of carbon; analysis of the gas contained in the blood after inhaling oxide of carbon; is water formed in the organism?

Successor to Professor Magnus.—This lately deceased *savant* is to be succeeded by Professor Helmholtz, from Heidelberg University, who has been elected by the Council of Berlin University a Professor of Physics.

Cosmos, July 9, 1870.

This number does not contain any original paper on matters related to chemistry or collateral sciences. A lengthy paper is devoted to—

The Arènes of Paris, and the Skeletons found there.—C. Bretagne.—To be continued.

And also a paper—

Reply to the Question, From whence do Meteorites come.—S. Meunier.

Revue Hebdomadaire de Chimie, June 9, 1870.

Ammonia Machine.—M. Frot.—Under this title, this and a preceding number contain a description (somewhat vague) of an improvement, or invention, by the author, whereby, instead simply of steam as moving power, a mixture of steam and ammonia gas are applied; but, notwithstanding what is said about the advantages resulting from this arrangement, it is not clearly stated how these advantages are to be gained. Some of our readers will, perhaps, recollect that, many years ago, the vapour of ether and steam, although acting separately, were tried in France instead of steam alone, but with no real success.

Furnace for the Distillation of Bituminous Shales.—MM. Champeaus and Pinard.—By the arrangement described by the authors at length, the carbonaceous matter contained in bituminous shales is partly utilised as fuel, to cause the distillation of oils obtainable from such shales.

Oven for the Smelting of Metals and Ores.—A. Bon.—In main principle, the contrivance described by the author is that in use for glass-blowing and glass-house furnaces, modified in a peculiar manner, so as to smelt metals with greater ease and less loss. The author has obtained a *brevet d'invention* for this furnace, which met the approval of the gentlemen present at the last meeting of the Société d'Encouragement.

Testing Glue.—Dr. Chabrier.—Apart from certain well-known physical properties of good glue, the author states that its goodness (depending on the quantity of pure gelatine it contains) may be tested quantitatively for that substance by the use of nitrate of peroxide of mercury in acidulated (with nitric acid) solution, the solution having been previously titrated with a solution of pure gelatine of known strength.

June 16, 1870.

Analysis of Hops Grown in the Elsasz.—C. Mène.—In 100 parts, this material contains—Water, 14·5; essential oil of hops, 0·5; resin, 15·9; tannic acid, 3·02; gum, 11·10; coloured extractive matter, 6·40; salts soluble in water, 0·25; cellulose and other matters insoluble in water and alcohol, 48·33.

Manufacture of Artificial Manure from Native Phosphates.—C. Mène.—This paper describes the preparation of superphosphate manure, but does not contain anything novel on this subject.

June 23, 1870.

Decolouration and Defecation of Saccharine Juices by means of Phosphates and Alumina.—M. Dominique.—The treatment of these juices remains as usual until after the defecation by means of lime; after that, phosphate of ammonia is added, until the juice is slightly alkaline; when tested with red litmus paper, a flocculent precipitate ensues, a mixture of tribasic phosphate of lime and gelatinous hydrate of alumina; this precipitate takes up all the colouring matters and other impurities, leaving the decanted liquid clear and bright. The precipitate is rich, also, in nitrogenous matter, and may be applied as manure, or, treated with sulphuric acid, for the recovering of the phosphoric acid.

Watering the Streets with Saline Solutions instead of with Water only.—Ch. Mène.—The author states that, of the two deliquescent salts which have been applied for this purpose—viz., the chlorides of magnesium and calcium—the last-named suits best, the quantity being adjusted at 250 grms. per square metre. It appears from this paper that, in 1860 and 1863, the Place Bellacour, at Lyon, was (experimentally, and during great heat), watered with a mixture of chloride of calcium and commercial hydrochloric acid, properly diluted in water, the effect being highly appreciated by the inhabitants also on account of the perceptible purification of the air.

Mixture to Render Textile Fabrics Impermeable to Water and Incombustible.—M. Imbert.—Steep the fabrics, first, in an aqueous solution of bichloride of mercury (sp. gr., 1·091); next, in a solution of protochloride of nickel (sp. gr., 1·286); then, in a solution of chloride of zinc (sp. gr., 1·359), followed by dusting over 1 part of chromate of lead; this to be followed by an ammoniacal copper solution, and, lastly, a bath of tartaric acid. The above is exactly reproduced from the French text; but we must observe that, in the first

place, the use of bichloride of mercury, a very poisonous salt also, may affect the colours of dyed fabrics, and that no fabrics, either of wool, silk, linen, or cotton, be they white or dyed, will bear the steeping into the solutions alluded to without injury to the fibre as well as the dye. There are, for the purpose the author desires to attain, simpler and better means.

Bulletin Mensuel de la Société Chimique de Paris, June, 1870.

From the *procès verbaux* of the meetings of this Society, we learn that M. Berthelot related his experiments on the action of phosgen gas (oxychloride of carbon) upon the aromatic hydrocarbons. Among these, the acenaphthen is attacked, the result being the formation of a hydrocarbon less rich in hydrogen, and the evolution of carbonic and hydrochloric acids. Naphthaline is not acted upon by the gas alluded to, even at 230°, neither is benzol at that temperature; but, at 320°, that latter body is strongly acted upon, becoming carbonised, but no chloride of benzoyl is formed. The same speaker next related his researches on trichlorhydrine and bodies isomeric therewith, stating that the trichlorhydrine obtained from glycerine differs from the rest of the isomeric bodies alluded to, by yielding, in the presence of water at 160°, glycerine again. The speaker also pointed out the differences existing between the boiling-points of these isomers and that of their respective derivatives. Dr. Schützenberger related his experiments on the action of sulphuric anhydride upon the chlorides of carbon. With the tetrachloride of carbon, the anhydride yields oxychloride of carbon, $COCl_2$, which latter may be readily obtained in liquid state by this mode of preparation. With perchloride of ethylen, C_2Cl_4, and the anhydride, a strong reaction takes place, but the products are difficult to separate; at 60°, a liquid comes over which, on standing for twenty-four hours, deposits a crystalline compound, $C_2Cl_4SO_3$. The sesquichloride of carbon, C_2Cl_6, heated with sulphuric anhydride, yields the oxychloride, C_2Cl_4O, according to the following equation:—

$$C_2Cl_6+2SO_3=S_2O_4Cl_2+C_2Cl_4O.$$

The same speaker referred to his experiments, whereby chlorine and oxide of carbon are simultaneously made to act upon spongy platinum, the result of which is the formation of a crystalline compound, fusing at 132°; formula, $C_2O_4Pt_2Cl_4$.

This number contains the following original papers:—

Some Facts relating to the Chemical History of Nitric Acid.—E. Bourgoin.—The chief object of this paper is to communicate the author's experiments on the action of nascent hydrogen upon nitric acid. The results of these experiments, which are related at great length, may be summarised as follows:—The action of nascent hydrogen upon nitric acid, $NO_3H_2O_2$, gives rise to the formation of nitrous acid, deutoxide of nitrogen, nitrogen, and ammonia. The production of nitrous acid is illustrated by $NO_3H_2O_2+H_2=NO_3+3H_2O_2$.

Contribution to the History of the Metallic Benzoates.—F. Sestini.—The author describes, at great length, the following salts:—Benzoate of potassium, $KC_7H_5O_2+3H_2O$; and the benzoates of sodium, magnesium, aluminium, zinc, nickel, cobalt, copper, tin, and iron. As regards the latter—viz., the protoxide salt—the author observes that it is erroneously stated, in works on chemistry, that this salt is crystallisable and very soluble. The author states that it is a salt which so rapidly oxidises, that he could not even determine its composition; while, as regards the existence of a crystalline peroxide compound of iron and benzoic acid, the author states that no such salt exists.

Action of Vapours of the Alkali Metals upon Molten Cast-Iron.—C. Girard and J. Poulain.—By keeping the vapours of the alkali metals at a pressure of 5 and 6 atmospheres, and temperatures ranging from 200° to 250°, and introducing into the thus-fused metals molten cast-iron, the authors produce alloys of iron and the alkali metals (potassium or sodium, or even alloys of these two). They describe, at length, the properties of the alloys thus obtained; and state that one of the practical applications of their labours bears upon the production of both steel and cast-iron of good, and even superior quality, from ores otherwise not well suited for smelting. Instead of the direct action of the vapours of sodium or potassium, the same result can be obtained on the large scale by adding, to the iron ore, fuel, and flux, a certain quantity of either chloride of sodium, or carbonate of soda, or the corresponding potash salts.

Action of Oxychloride of Carbon on the Hydride of Octyl.—MM. De Clermont and Fontaine.—The aim of the authors has been to try whether the general method of synthesis of the volatile fatty acids, as described by T. Harnitz-Harnitsky, is applicable to the higher class of bodies of the acetic and caproic acids series; they therefore experimented with the hydride of octyl, but found that, notwithstanding the application of all requisite means as regards temperature and pressure (sealed tubes), no action took place between the hydride alluded to and the oxychloride of carbon.

Les Mondes, June 30, 1870.

Experiments made with the Oxyhydrogen-Light at Beauvais (Oise, France).—From a letter to the Reverend editor of the above-named periodical, it appears that a successful series of experiments has been made with the view of testing the qualities of this new mode of artificial light (Tessié du Motay system), previous to its introduction into the city of Beauvais for general daily use; it appears that the oxyhydrogen-light is, in France, fast superseding the ordinary coal-gas. The population of the city alluded to is below 20,000.

Quinquina-Chocolate.—Dr. Heuzé.—The author has succeeded in preparing an extract of Peruvian bark so as to possess no unpleasant bitter taste, and this is mixed with pure chocolate paste, so as to form readily-portable, and, at the same time, an agreeable, dietetic, medicine. This preparation is (thus it was stated at a meeting of the Central Imperial Society of Agriculture) considered superior to the sulphate of quinine.

New Astronomico-Meteorological Observatory.—The Government of the Argentine Republic, South America, have in view the establishment of an observatory at Cordova (a town of 25,000 inhabitants), at 30½° S. lat.; Dr. B. A. Gould has been appointed as Director and First Astronomer.

Chemical Nomenclature.—Dr. Cap.—The author states that he received from one of the Professors of Chemistry of a Departmental Lyceum, the proposal that, instead of the French names for ice (solid water), water, and steam or aqueous vapour, there should be used, *stéarhyde*, or *stéarèse d'oxyure d'hydrogenium*; for water, *calorhyde*, or *calorèse d'oxyure d'hydrogenium*; for aqueous vapour or steam, *gazorhyde*, or *gazerèse d'oxyure d'hydrogenium*. In this way the language of science would become more difficult to learn than the science itself.

Bleaching Ivory.—Dr. J. Artus.—The objects made of this substance are first placed into a solution, containing 227 grms. of soda (carbonate) in crystals, and 907 grms. of water. After having been left in this fluid for two days, the ivory objects are well washed in pure water, and then immersed into a solution, composed of 340 grms. of sulphite of soda, and 906 grms. of water, and kept therein, for five or six days, after which time there is added to the liquid, yet containing the ivory objects, 28 grms. of hydrochloric acid diluted with 112 grms. of water. After the acid has been added, the vessel (glass or porcelain), containing the liquid and ivory, should be covered, and left standing for from 24 to 36 hours, after which time the ivory is taken out, washed in clean water, and dried. The quantities of ingredients herein specified suffice for 453 grms. of ivory.

NOTES AND QUERIES.

Extract of Meat.—(Reply to Thos. Wells.)—Refer to Dr. Dr. J. von Liebig's paper (*Annalen der Chemie und Pharmacie*, vol. 146, 1868, p. 132).

Benzol.—(Reply to "A Subscriber.")—Refer to the work on Aniline Dyes, by the Editor of this paper. As for apparatus, there are several dealers in these and all articles required by chemists in every large town.

Cement.—(Reply to "C. H.")—In all likelihood, the cement known as zeiodelite will answer your purpose. Space forbids us to enter into particulars on this subject, for which we refer you to "Hand und Lehrbuch Der Technologie," von J. R. Wagner, vol. v., p. 210 and following, and to Cooley's "Cyclopedia of Practical Receipts," &c., both of which works you may inspect at the Library of the Commissioners of Patents.

Analysis of Alloys.—I have been analysing some alloys of copper, zinc, and tin, and was surprised at finding as much as 6 per cent of iron in them; but, suspecting the cause to be the breaking away of the teeth of the file, while minutely dividing the alloy before dissolving it, I drilled a hole in parts of the same brass with a carefully-tempered drill, and then found very slight traces of iron, indeed not more than 0·5 per cent in any case, most likely caused by impurity of the zinc used. I merely mention this as showing how careful one need be. The fact of the teeth of the file breaking away is well known to those who use them much, and consequently the cause of the presence of the iron was at once obvious.—T. W.

TO CORRESPONDENTS.

*** Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

J. Douglas.—This correspondent wishes for particulars of Philipp's carbo-oxygen lamp mentioned in our issue of July 9th.

H. Shuker.—If quite purified, it would answer the purpose, but it is a difficult thing to purify.

P. H. M.—The process certainly appears feasible, but we would advise you to experiment on the large scale before taking out a patent.

T. E. Thorpe.—Received.

W. H. Perkin.—Thanks for your communication.

Dr. W. H. Wahl is thanked for his courtesy. The communication will appear.

L'Abbé F. Moigno.—We have forwarded the pamphlets.

Dr. E. H. von Baumhauer.—We are much obliged for the Reports and Programme. We should have much pleasure in acceding to your request, but, unfortunately, many of the earlier numbers of the CHEMICAL NEWS are out of print.

THE CHEMICAL NEWS.

VOL. XXII. No. 557.

ON THE PLATIN-AMMONIA COMPOUNDS.

By S. E. PHILLIPS.

SOME twenty years ago Laurent and Gerhardt endeavoured to clear up an obscure subject by the assumption that there were two platinums—Platinicum = pt (49); Platinosum = Pt (98).

Hydrochlorate of platinosum was $NH_2Pt + HCl$.
Hydrochlorate of di-platinicum was $N_2H_5pt_2 + HCl$.
Hydrochlorate of platinamine was $NHPt + 2HCl$.

As I found the *platinicum* very conveniently chose to appear always in the twin form, I had no difficulty in discarding it, and also forgetting the *platinosum* in the orthodox platinum of that atomic weight. Since then an inverse twin process has given birth to a diatomic platinum = 197, adopted by Prof. Odling and very widely accepted.

An extended criticism of the above attempt lies before me dated 1850, pointing out the secret involved, of the ureal type of ammonia; showing how simply and clearly old views covered the complex ground taken, and bitterly complaining of the want of discrimination in mixing together simple and definite types with complex or hybrid forms as the basis of sweeping innovations.*

In a late digest, prepared as a study in connection with the recent views of M. Wurtz, I had prepared a condensed outline statement, but I lay this aside in favour of the synopsis furnished by Dr. Odling in his lecture at the Royal Institution, June 8, 1870. My results were tabulated thus:—

Type—AMMONIUM.

H_3HN,O. Ammonium.
H_3PtN,Cl. The chloride. (Green salt of Magnus).
H_3PtN,O. The oxide. { (By heating the hydrate of Reiset's salt).
$H_3PtN,Cl + PtCl_2$. The chloro-platinate.
$H_3PtN,O + SO_3$. The sulphate.

H_3PtN,Cl_2. The bichloride. { (The chloride of Reiset and Gerhardt).
$H_3PtN,O_2 + 2NO_5$. The nitrate.

$H_3PtN,O_2 + NO_5$. The nitrate.
$HPtN,O_2 + HO$. The hydrate.
$HPtN,O_2 + 2SO_3$. The sulphate.
{ (Under these are comprised some hybrid (?) forms with OCl instead of Cl_2 or O_2.

Type—ATMONIUM.

H_6PtN_2,O. Atmonium.
H_6PtN_2,Cl. The chloride. (Reiset's salt).
H_6PtN_2,O. The oxide.
H_6PtN_2,S. The sulphide. (Also the iodide, bromide, &c.)
$H_6PtN_2,O + HO$. The hydrate.
$H_6PtN_2,O + NO_5$. The nitrate. (Also two carbonates).
$H_6PtN_2,O + SO_3$. The sulphate.

$H_6PtN_2,Cl + PtCl_2$. The chloro-platinate. { (The green salt of Magnus(?)

H_6PtN_2,Cl_2. The bichloride. (Series of M. Gros).
$H_6PtN_2O_2$. The binoxide.
$H_6PtN_2O_2 + 2NO_5$. The binitrate.
$2(H_6PtN_2O_2) + 3NO_5$. The sesqui-nitrate.
$H_6PtN_2O + 2SO_3$. The bisulphate.

* Dr. Odling says, "The scheme of Gerhardt, though always treated with respect, has never met with general acceptance, and now-a-days, at any rate, is open to very serious objections.

If space permitted, we might go into further details, to show that herein types and constitutions go hand in hand. The exceptional binoxide and bichloride bases are more insoluble and unstable than the more normal types, and the manifest tendency to bi- and sesqui-saltic forms is fairly paralleled in ordinary mineral types. It now only remains to enquire what has been done in this long interregnum; and here we may appropriately introduce the modern views as enunciated by M. Wurtz. He maintains that monatomic metals replace H atom for atom.

$\left.\begin{matrix}(C_4H_5)\\H\\H\end{matrix}\right\}N$ $\left.\begin{matrix}Na\\H\\H\end{matrix}\right\}N$ $\left.\begin{matrix}K\\H\\H\end{matrix}\right\}N$

Ethylamine. Amidide of sodium. Amidide of potassium.*

But the diatomic metals, copper, cobalt, mercury, &c., replace two atoms of H, and thus correspond with ethylene.

$\left.\begin{matrix}\text{Co}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2$ $\left.\begin{matrix}\text{Cu}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2$ $\left.\begin{matrix}\text{Cu}_2''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2$ $\left.\begin{matrix}\text{Pt}''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2$ $\left.\begin{matrix}(C_4H_4'')\\H_2\\H_2\\H_2\end{matrix}\right\}N_2$

Cobalto-sonium. Cupri-sonium. Cupro-sonium. Plato-sonium. Ethylene Ammonium.

We object to this form of representation. As in the former case, the rule is to notate the ammonia H_3N, and the ammonium H_4N,O; so, in the latter, the atmonia, H_6N_2 or H_3N, should not be confused with the atmonium-type, H_7N_2,O. Both pairs have their well-marked and distinguishing characteristics; and the question herein is to what extent these oniums may be simply double atoms of the former.

We have the ordinary ammoniacal sulphate of copper, $H_6CuN_2O + SO_3$, to which, I believe, the ordinary acetate corresponds; but the oblique rhomboidal prisms of acetate may be $H_3CuN,O + AcO_3$.

It is notated by M. Wurtz as—

$$\left.\begin{matrix}\text{Cu}_2''\\H_2\\H_2\\H_2\end{matrix}\right\}N_2 + 2C_2H_3O.O.$$

This certainly is a new phase of diatomic fancy—to notate $(H_6Cu''N_2)''(=H_8N_2)$, which, with the magic double touch, is supposed, *therefore*, to combine with 2 atoms of monatomic —— (?), $(C_2H_3O.O)'$. I know nothing of either entity as such; nor can I admire a system which seems to pride itself in calling $PtCl_2$ protochloride of platinum, and $(C_4H_4)''Cl_2$ chloride of ethylene. Time was when the consistency of nomenclature was studied; but, now that the requirement has multiplied itself a thousandfold, the rules of common sense are expressly violated.

I have pointed out (CHEMICAL NEWS, vol. xxi., p. 122) that copper evinces a peculiarity of isomeric change, or atomic condensation, which has not been adequately appreciated; and it is not at all improbable that Pt may exhibit the same affection. But it gives no support to diatomic theory; for, in either case, it is clearly manifest that only 1H is replaced.

All the cases given by M. Wurtz of monatomic substitution are in the type of ammonia, while all the cases of diatomic substitution involve the type ammonium; and most or all of them are capable of a simple halving of the atomic weight. If such be invalid, then it is deplorable that no evidence is given *per contra*,—the more so as Bloxam has well pointed out that such a distinction can be exemplified by their different behaviours with reagents, as ably embodied in the researches of Hadow.

Wurtz says that, when ammonia is made to act upon cuprous iodide, $Cu_2''I_2$, there are 4 molecules of ammonia

* We have shown that the same principle holds good equally with alleged diatomic metals.

$\left.\begin{matrix}Zn\\H\\H\end{matrix}\right\}N$ $\left.\begin{matrix}Cu\\H\\H\end{matrix}\right\}N$ $\left.\begin{matrix}Pt\\H\\H\end{matrix}\right\}N$ $\left.\begin{matrix}(CO)\\H\\H\end{matrix}\right\}N$

retained to a well-defined crystalline compound, $Cu_2''I_2+4H_3N$; and, from this, *as a basis*, is led off another theory—that H_4N may replace 1 atom of H in a complex type of ammonia.

Thus the ordinary sulphate we have referred to becomes—

$$\left.\begin{matrix}Cu_2''\\Am_2\\H_2\\H_2\end{matrix}\right\}N_2,2SO_3aq.$$

Now, why is this not a simple iodide of the type so well recognised in the ordinary sulphate alluded to, viz.—

H_6CuN_2,I, the iodide;
$H_6CuN_2,O+SO_3$, the sulphate.*

It is in this way the ammonium of Reiset's salt is said to contain 4 atoms of N; but it is useless to wade through such numerical guesses of diatomic type without one tittle of chemical evidence or reasoning.

We therefore pass on to the only new fact in this connection, viz., that Hofmann "has proved that methylamine, Me_3N, may unite with bromide of ethylene, $(C_4H_4Br_2)$, to form a bromide. Well, be it so. But surely it is no novelty that 1Br should replace 1H; hence it may be a bromide of Me_3EN,Br where E contains 1Br replacing 1H. Moreover, it is expressly alleged in the context, with a positivity I claim no pretension to in much simpler cases, that (C_4H_4Br) does replace 1H.

While ignoring the intelligent researches of Hadow, the extended play in modern memoirs upon monacid and for diatomics, diacid ammonias, is exceedingly questionable.

Professor Odling's Scheme of Platin-Ammonia Compounds.

It is always a pleasure to sit at the feet of this gifted exponent of modern research; and anyone who has heard his unassuming and eloquent lectures at the Royal Institution must feel a pleasureable complacency in seeing that the acceptable mantle of Faraday has fallen upon such able shoulders. But, in this case, our object is rather to criticise a few weak points of a system than to enlarge on the great skill and ability which usually characterise his treatment of subjects.

The first point noticeable involves a continuation of our concluding reference to M. Wurtz—"The double ammonia unites with 2 atoms of HCl to form the hydrochloride." This, in any special sense, is precisely what we cannot see. A simple ammonia must combine with 2 atoms of HCl precisely in the same way that an atmonia or doubly-condensed ammonia does, in both cases to produce the same character of so-called "hydrochloride."

$$H_3N+2HCl=H_4N,Cl+HCl.$$
$$H_6N+2HCl=H_7N,Cl+HCl.$$

And this principle is equally paramount in the varied metallic or other substitutional forms of either type.

Of course we may *numerically* represent the simple ammonia as combining with 1 atom of HCl, and the "double ammonia" with 2 atoms; but, in doing so, the former is necessarily a chloride, like sal-ammoniac or chloride of potassium, while the latter is a chlorhydrate and strictly comparable hydrate of potash, KO+HO, or other hydrates or chlorhydrates. Indeed, this is really implied in the following comparative tabulation:—

Monatomic.

$KCl\}C_2H_3(H_2N)H\}'Cl$	$KCl\}H_4N,Cl.$
$KHO\}C_2H_3(H_2N)H\}'HO$	$KO+HO\}H_4N,O+HO.$

Diatomic.

$Ba''Cl_2\}C_2H_4''(H_2N)_2H_2\}''Cl_2$	$Ba_2Cl_2\}H_8N_2,Cl_2.$
$Ba''(HO_2)\}C_2H_4''(H_2N)_2H_2\}''(HO)_2$	$Ba_2O_2+\}H_8N_2,O_2+2HO.$

* A. Cahours and M. Gal (see CHEMICAL NEWS, vol. xxii., p. 22) describe new derivatives from "tri-ethyl phosphine." A prismatic, colourless salt is thus notated, $E_6PtP_2.Cl$, and said to correspond with Reiset's salt, $H_6PtN_2.Cl$. These modern notations are in strict accordance with those I have mooted. At 100° C. the salt loses 1 equiv. of tri-ethyl phosphine, (E_3P), and would therefore contain $E_5PtP.Cl$.

In order to lessen the amount of hypothesis in this case, I have, in the second column, preferred to notate the H elements numerically, giving the imaginary double touches their intended value. This well pourtrays the confusion of M. Wurtz in notating the atmonial type as H_8N_2, when we know it should be H_7N_2.

The hypothesis herein is that the simple ammonia combines with 1HCl, and the atmonia with 2HCl. Whereas we have learned throughout a wide area that both normally combine with 1 atom to form the chloride, and with 2 atoms to form the chlorhydrate; and, further, that both in common have their bichloride and binoxide variations.

The Professor notates both simple and double forms as chlorides, and yet speaks of them as "hydrochlorides."

Now, as this cannot be true of the mineral types, and as this tabular comparison is well justified in the context, the conclusion is irresistible that, in both series alike, the first is a chloride and the second is a hydrate.

These may seem small things, and, compared with the practical and profound reasonings (in an eclectic sense) of the learned Professor, I admit their relative smallness; but I hold them in high esteem, and would illustrate their importance by comparison with a contemporary difficulty with an esteemed botanist who is treating of *Proteaceæ*, *Nucumentaceæ*, and *Folliculares*.

Now, if in a certain great class of vegetables we have an important *order* of *Proteaceæ*, it is clearly wrong to give it a merely *family* designation; and, if the order be so important and its family and genera so numerous as to require special sub-division, it is clearly confusing to give one of these a *family* designation, *Nucumentaceæ*, and to call another, of equal value or parallel position, *Folliculares*. It is no answer to this objection to say that the generally-understood arrangement of Botany and Zoology into primary divisions—classes, orders, families, genera, and species—may suffice for a popular treatment.

No doubt the rule is in certain circles to (in some measure) despise popular teachers; and truly the task imposed on them is too severe. I am well aware that, as in Chemistry, so in Botany, these little discrepancies (if they be so regarded) are no obstacle to those whose lives are devoted to the departments in question; but to the student, and even the popular teacher, they are great impediments. And I do hold that popular teaching should be correct teaching, and that, except in the degree or amount of minutiæ, it is wrong to have two standards of reference.

It will ennoble and exalt the position of our leading great men to have wider audiences; and, if the signs of the times demand a more general appreciation of the beauties and utilities of scientific knowledge, then I say that a double duty is involved. The people must and will respond by some effort on the one side; and the reports of our learned societies must be to some extent divested of a scientific jargon, which is too fatally exclusive for a reasonably wide appreciation.

But, returning to the tabulation, what may we say of the double atoms of oxide and chloride of barium? I prefer to let an accomplished chemist reply; one, moreover, who has walked and worked in the new ways.

Professor Wanklyn says:—

"That the present diatomic formulæ for salts of Ba, Ca, Mg, &c., should have come into general use, and that there should be next to no experimental support for these formulæ, is a most extraordinary thing, and speaks volumes for the depressed state of our chemical conservatives.

"The reasons in regard to some of these metals were partly some very doubtful deductions drawn from the specific heat of the metals, and mainly from considerations of the vapour-density of certain metallic compounds," &c.

I am indeed surprised and delighted to find the formidable notations of Dr. Odling agreeing so remarkably with my list above, which was projected some twenty years ago.

I now give a parallel comparative list:—

	Proposed scheme.	Old view.
PLATOSAMINE—		
The chloride	$Pt''(H_2N)_2.2HCl$	H_3PtN,Cl
,, hydrate	$Pt''(H_2N)_2.2H(HO)$	$H_3PtN,O+HO$
,, nitrate	$Pt''(H_2N)_2.2H(NO_3)$	$H_3PtN,O+NO_5$
AMO-PLATOSAMINE (Reiset's)—		
The chloride	$Pt''(H_5N_2)_2.2HClaq.$	H_6PtN_2,Cl
,, hydrate	$Pt''(H_5N_2)_2.2H(HO)$	$H_6PtN_2,O+HO$
,, nitrate	$Pt''(H_5N_2)_2.2H(NO_3)$	$H_6PtN_2,O+NO_5$
The ethyl-phosphine as notated by M. Cahours and M. Gal.		E_6PtP_2,Cl
PLATINAMINE (Gerhardt's)—		
The chloride	$Cl_2Pt''''(H_2N)_2.2HCl$	H_3PtN,Cl_2
,, hydrate	$Cl_2Pt''''(H_2N)_2.2H(HO)$ (?)	$H_3PtN,OCl+HO$
,, ,,	$(HO)_2Pt''''(H_2N)_2.2H(HO)$	H_3PtN,O_2+2HO
,, nitrate	$OPt''''(H_2N)_2.2H(NO_3)3aq.$	$H_3PtN,O_2+NO_5,3HO$
,, ,,	$(NO_3)Pt''''(H_2N)_2.2H(NO_3)$	$2(H_3PtN,O_2)+3NO_5$
AMO-PLATINAMINE (Gros's)—		
The chloride	$Cl_2Pt''''(H_5N_2)_2.2HCl$	H_6PtN_2,Cl_2
,, nitrate	$Cl_2Pt''''(H_5N_2)_2.2H(NO_3)$	$H_6PtN_2,OCl+NO_5$
,, ,,	$(HO)_2Pt''''(H_5N_2)_2.2H(NO_3)$	H_6PtN_2,O_2+NO_5,HO
,, ,,	$(NO_2)_2Pt''''(H_5N_2)_2.2H(NO_3)$	H_6PtN_2,O_2+NO_5,NO_3
,, ,,	$(NO_2)_2Pt''''(H_5N_2)_2.2HCl$	$H_6PtN_2,OCl+NO_3$
AMO-DIPLATINAMINE (Raewsky's)—		
The chloride	$Cl_2OPt_2''''(H_5N_2)_4.4HCl$	
,, nitrate	$Cl_2OPt_2''''(H_5N_2)_4.4H(NO_3)aq.$	
,, ,,	$(NO_3)_2OPt_2''''(H_5N_2)_4.4H(NO_3)aq.$	

I have followed herein a uniform system of halving the types given by Dr. Odling, but by no means contend that such is necessarily or in all cases correct.

Bloxam very reasonably contends that the green salt of Magnus, $H_3PtN.Cl$, should rather be $H_5Pt_2N_2Cl+HCl$ (or, as in my list, $H_6PtN_2,Cl+PtCl$), that is, a hydrate rather than a chloride.

In this, as in many cases, the probability is great that both forms subsist in analogous cases.

It is most improbable that all platinum substitutions (as in my list) should be mono substitutions; and it is still more improbable that all the series should contain two atoms of Pt, as in Dr. Odling's list. The truth, in all probability, lies between the two extremes; but the pity is, that, while valid bases of discrimination subsist, the matter should be left to the empiricism of individual preference and merely numerical analogies.

Platinum forms no exception to the general facts of substitutional interchange and variation, and the alleged distinctions between mono-, bi-, and tri-atomic elements of substitution may possibly prove to be as fanciful as they are elaborately and ingeniously pourtrayed.

If we instance the radicals of biatomic glycol, or triatomic glycerine, we find that both derived acids are *admittedly* monatomic. And, what is far more to the point, both are derived by an identical process to that which gives acetic acid from alcohol; and, as the latter gives either ethylamine or acetamide, so the former give their corresponding amines or amides—

Ethylamine $(C_4H_5)H_2.N$. Acetamide $(C_4H_3O_2)H_2.N$.
Glycolamine $(C_4H_5O_2)H_2.N$. Glycolamide $(C_4H_3O_4)H_2.N$.
Glyceramine $(C_6H_7O_4)H_2.N$. Glyceramide $(C_6H_5O_6)H_2.N$.

And similarly in corresponding sulpho-acids and other derived and substitutional forms. But, in regard to the platinum case in question, the radicals of carbonic and oxalic acid have a closer bearing on the subject. With these we have—

AMMONIA.

$\underbrace{(CO)H_2}.N.$	$\underbrace{(C\Theta)H_2}.N.$
Carbamide.	Oxamide.
$\underbrace{(CO)_2H_2.NO+HO}.$	$\underbrace{(C\Theta)_2H_2NO+HO}.$
Carbamic acid.	Oxamic acid.

ATMONIA.

$\underbrace{(CO)_2H_4N_2}.$	$(C\Theta)_2H_4N_2$ (?).
Urea.	
$\underbrace{(CO)_2H_5N_2O+HO}.$	$(C\Theta)_2H_5N_2O+HO$ (?).
The hydrate.	
$\underbrace{(CO)_2H_5N_2O+NO_5}.$	$(C\Theta)_2H_5N_2O+NO_5$.
The nitrate.	

&c.

Let copper replace (CO), and we have another homologous series, where Cu(31·5) and Cu(63) equally replace one atom of H to the production of similarly-varied types.

The remarks of Dr. Odling on the platosamine group are very varied and interesting, and, in an eclectic sense, exceedingly cogent and well put.

I also believe in "the parallelism in constitution and properties of the two compounds, and of their corresponding hydrates," and, still further, that neither contains any diatomic element *per se*, or replacement of 2H; but I say nothing of ethylenamine in this connection, being engaged on an extended study of the diatomic hypothesis.

AMO-PLATOSAMINE.

What these are may be seen by a glance at either scheme of notation; they are simple repetitions of the preceding with H_3N superadded—in fact, they are doubly-condensed ammonias, or, as we have called them, atmonias.

PLATINAMINE COMPOUNDS.

In all these, the mode of preparation is instructive; they are forced conditions under the influence of nitric acid or permanganate; and hence the resulting binoxide or bichloride forms of the preceding types, which is especially manifested by the tendency to bi- and sesquisaltic types so common in such cases.

It is curious to observe that the three cases selected from Raewsky are, with one little variation in the third instance, precisely double those of the first three of M. Gros's series.

In conclusion, I have merely to observe that this paper has no pretension to any adequate review of the proposed scheme of Dr. Odling, which has the great merit of associating *chemical* with other considerations, and well deserves a higher tribunal.

ON SOLUTIONS: HISTORICAL NOTE.

By CHARLES TOMLINSON, F.R.S.

Those who take any interest in studying the history of science must have felt some surprise at seeing Swedenborg's claim to what has been considered as an important modern discovery in Physics advanced in Prof. Beswick's interesting paper in a recent number of the CHEMICAL NEWS (vol. xxii., p. 25).

Swedenborg's reputed discovery that in the solution, say, of a salt in water "the saline particle in the water does not increase the space, but only occupies the void;" or, in other words, "the mere particles of salt cannot at all add to the bulk, but only to the weight, because they occupy the spaces between the aqueous particles," is not, I am inclined to think, so Swedenborgian a proposition as Prof. Beswick supposes. I do not mean to say that earlier writers announced the fact in the same words, but the fact followed, I think, naturally from the theoretical teaching of the previous century.

For example, Descartes (born 1596—died 1650) illustrates the porosity of matter by supposing a number of apples or of bullets, very smooth and round, to be tied up in a net so as to form a compact solid. Whichever way you turn this solid and throw upon it small shot or any similar sphericules, they will pass completely through this body by their weight.

Gassendi (born 1592—died 1655), whom Bayle describes as "the greatest philosopher among scholars and the greatest scholar among philosophers," adopts a similar figure to illustrate the porosity of water. He supposes a bushel measure to be filled with wheat; there must then be between the grains certain small spaces void of grains: so among the corpuscles of water or of air, there must be small spaces which, not being filled either with water or air nor with any other body, are absolutely void.

In another place he speaks of silver dissolved by aqua-fortis and diffused through its little pores.

But the most remarkable passage bearing on the point in hand that I have met with in this very suggestive writer is the following:—"I have long known," he says, "that water can dissolve a certain quantity only of salt, and being once saturated with it the rest remains undissolved. Hence it occurred to me that, the salt being thus reduced to very small particles, *there must exist in the water certain small spaces capable of receiving them, which spaces being filled up, solution ceases.* It further occurred to me that the corpuscles of salt being cubical might really fill up small spaces which were also cubical. But since the same water could not only dissolve common salt, but also alum, which has an octahedral figure, but also nitre, sal-ammoniac, sugar, and other bodies, which have all different figures, there must, then, also exist in the water octahedral, &c., spaces, so that water being saturated with one of these salts is not prevented from dissolving the others. In effect, my conjecture was right; for having thrown a morsel of alum into water which some days before had been impregnated with common salt, it was dissolved just as if there had been no common salt present; and not only alum, but some other salts that I threw in were dissolved; from which I concluded that there must exist in water a number of insensible spaces of different figures; and I now understood how it was that water saturated with tinctures of rhubarb or of senna or matters ordinarily obtained by infusion is not so saturated with one as to be incapable of taking up another,"—(Vol. iii., p. 182*).

It seems to me to follow, from the passage italicised in the above quotation, that the salt with which water is saturated (to use the words of Swedenborg once more), "does not increase the space, but only occupies the void."

Musschenbroek (born 1692—died 1761) published the first edition of his Physics in 1726, and the second in 1734, an English translation of which was published by Colson in 1744. I have not had an opportunity of examining the original, but in the translation, p. 252, the following passage occurs:—"If fluids are composed of spherical or spheroidal corpuscles, they must leave many interstices between them, into which lesser parts can insinuate without the intumescence of the whole mass. Hence salt dissolved in water fills up the interstices, which will be done still more accurately if sugar be then added, and more still by the further addition of alum."

If by *intumescence* is meant "increase in bulk," we have the fact familiarly announced by a well-known investigator in physics in that unconscious manner in which an old and admitted fact is handled. Moreover, in the early part of this treatise there is a good deal of interesting speculation about the shapes of the porous spaces, and calculations as to their magnitudes.

In another once well-known treatise by Clare, "On the Motion of Fluids,"* the well-worn metaphor is used in which water is represented by bullets in a barrel, the interstices between the bullets will contain a great many small shot, "the vacuities of the shot may then be replenished with a certain quantity of sea sand, the interstices of the grains of sand may again be filled with water, and thus may the weight of the barrel be greatly augmented, without increasing the general quantity.† Now this being true with regard to solids is applicable also to fluids. For instance, river water will dissolve a certain quantity of salt, after which it will receive a certain quantity of sugar, and after that a certain quantity of allom, and perhaps other dissoluble bodies, *and not increase its first dimensions.*"

Such is the teaching of all the treatises I have seen about the time when Swedenborg is said to have announced his discovery. It seems to me that the teaching was adopted from Gassendi, which, being nearly a century old, was taken so much as a matter of fact as not to require the special notice it would certainly have met with had it been first pointed out by Swedenborg in 1721-2.

Mr. Beswick supposes that, between the date of Swedenborg's book and Dalton's essay, in 1840, the important fact in question remained unknown, and consequently fruitless. We have already seen that it was not unknown; we have now to show that it was taken up as a good working suggestive fact.

In the memoirs of the Royal Academy of Sciences of Berlin for the year 1750 is a long paper, by Eller, in which are described a number of experiments for determining exactly the quantity of each kind of salt which conceals itself in the water (*qui se cache dans l'eau*) without augmenting the volume, or the vessel in which the operation is conducted becoming fuller. A glass globe of 8 ounces' capacity, with a tube fitted to the neck 10 or 12 inches in length, and 3 lines in internal diameter, was filled, for each observation, with distilled water up to a mark half way up the stem. Each kind of salt was purified and reduced to powder, the temperature being taken in degrees of Réaumur. The 8 ounces of water dissolved the following quantities of the substances named, without any increase in bulk:—

	Drs.	Grs.		Drs.	Grs.
Green vitriol ..	1	10	Seidlitz salt.. ..	1	0
Blue vitriol	0	40	Sal de Seignette..	1	0
Ditto, calcined ..	2	0	Soluble tartar ..	2½	0
White vitriol ..	1½	0	Borax	½	0
Alum	0	40	Sugar of lead ..	0	40
Ditto, calcined ..	0	50	Refined sugar ..	0	30
Saltpetre, refined	1½	0	Sal ammoniac ..	1	20
Common salt ..	1	40	Fixed alkali.. ..	2	0
Cream of tartar ..	0	50	Ammonia Carb...	0	40
Glauber's salt ..	1½	0	Gum Arabic ..	1½	0
Epsom salt	1½	0	And a number of other solids.		

* I quote from the "Abregé de la Philosophie de Gassendi," en vii. tomes, par F. Bernier: Lyon, 1684. There is a copy in the Library of the Royal Society "Presented by the Author, An° 1685." The original Latin of the passage quoted is in Gas. Phys., l. i., sec. i., cap. iii.

* My copy is the *third* edition, bearing the date 1747.

† *Query*, volume.

All the reasoning in this paper is evidently derived from Gassendi; for example, Mr. Eller says—"No one doubts the porosity of matter; and the preceding phenomena also prove, I think, the existence of interstices among the spherical bullets (*boules*) which form the ultimate elements of the water. I shall not decide whether these pores are triangular, square, pentagonal, or polygonal, so as to assist or refuse entrance to the molecules of the salts which are of different figures. Water, by its intrinsic motion, separates and divides the salt into invisible atoms, probably as small as those of the water, so that they are adapted to thread the pores of the water and become equally distributed among its mass, which holds them suspended and floating by its interior movements, notwithstanding their excess of weight. But the pores of the water being, probably, different among themselves, as the molecules of different salts are, it follows that the homogeneous molecules of one kind of salt can fill only those pores of the water that are adapted to it, while the same water can receive other molecules, whose figures are different from those of the first." Thus, 8 ounces of water saturated with 9¼ ounces of green vitriol (at 11° or 12° R.) can still dissolve 1¼ ounces of Seidlitz, 2 drachms of refined saltpetre, and 3 ounces of refined sugar; or, the water that has dissolved 2¼ ounces of alum can also dissolve 6 drachms of common salt and 1 drachm of Epsom salt.

Mr. Eller also points out (page 92) that mercury will dissolve certain metals without any increase in bulk.

In the *Philosophical Transactions of the Royal Society* for 1770 is a paper by Dr. (afterwards Bishop) Watson, "On the Phenomena Attending the Solution of Salts," from which it appears that the writer failed in attempting to repeat Mr. Eller's experiments.

I have no doubt that, with a little more research, other papers might be found bearing on the point in question. At any rate, it seems scarcely justifiable that so eminent a man as Dalton should, so late as 1840, suppose himself to be the discoverer of these facts, and refer to them as "the greatest discovery I know of next to the atomic theory." Scientific workers and scientific historians form two distinct classes, and the former do not hold the latter in much esteem. In the same way, a first-rate chess player is seldom or never a good problem composer, and as the latter is never the former, he is placed on a low chess level by the Philidors of the clubs.

I ought, perhaps, to add, by way of caution to the student, that the observations of facts above quoted may require a good many *errata;* these are supplied by Messrs. Playfair and Joule (*Phil. Mag.*, xxvii., 1845).

Highgate, N., July 21st, 1870.

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

(Continued from p. 42).

COMMERCIAL magenta consists of brilliant crystals, sometimes half-an-inch in length, having a beautiful golden-green metallic appearance; these dissolve in warm water almost entirely, forming an intense purplish red solution. Dr. Hofmann has carefully studied the chemical nature of magenta, and has found it to consist of the salt of an organic base, which he has called rosaniline. This base may be obtained from the commercial product, by dissolving it in water and boiling it with an alkali, or alkaline earth such as ammonia, potash, or lime; it is thus rendered nearly colourless, and after filtration rosaniline separates from the clear solution, on cooling, in colourless crystals. It is composed of carbon, hydrogen, and nitrogen when anhydrous, but generally contains an equivalent of water also. The anhydrous base has the formula—

$$C_{20}H_{19}N_3.$$

* The Cantor lectures, delivered before the Society of Arts.

This colourless base immediately becomes dark red upon combining with an acid, as I can show you by heating some with acetic acid, when the colour is immediately developed. The magenta produced by heating commercial aniline with nitrate of mercury is the nitrate of rosaniline; that produced with arsenic acid is the arseniate, but in the process of purification this latter salt becomes converted into hydrochlorate, which is the salt most generally found in the market. Other salts are also commercially manufactured, such as the oxalate and acetate, especially when a very pure product is required; these salts are generally prepared from pure rosaniline, by combining it with the required acid, and crystallising from water.

The acetate of rosaniline crystallises in magnificent octahedra, possessing the ordinary golden-green metallic lustre to a very high degree; it is also the most soluble salt of rosaniline known. The affinity of rosaniline salts for animal fibres is very great; it does not, however, resist the action of light nearly to the same extent as the mauve. All the derivatives of rosaniline also possess a very great affinity for animal fibres, in most cases quite equal to that of magenta itself.

When speaking of aniline purple, I showed you that by reducing agents it became colourless, or nearly so, but that the original colour was developed when it was exposed to the oxygen of the air. Salts of rosaniline or magenta are also decolourised by reducing agents, but, unlike aniline purple, the colour is not restored by exposure to the air. Dr. Hofmann has found that in this case a new organic base is produced which he has called leucaniline. This substance differs only from rosaniline in containing an additional quantity of hydrogen. It may be re-converted into rosaniline by oxidising agents such as bichromate of potassium, &c.

There is another very peculiar reaction of rosaniline. This base, when brought in contact with hydrocyanic acid, instead of forming a coloured hydrocyanate of rosaniline, yields a perfectly colourless body, which is not a salt but a base. This remarkable fact was discovered by Dr. Hugo Müller, and he has called this new body hydrocyanrosiline. We shall have occasion to refer again to this substance and leucaniline.

In the formation of magenta, a second product is obtained, commercially called phosphine. This substance was first introduced by Mr. E. Nicholson. Dr. Hofmann has investigated it, and found it also to contain an organic base, which he has called chrysaniline.

Phosphine or chrysaniline is not capable of being produced at will, and the quantity formed in the manufacture of magenta is variable. In shade it is of rather a yellow orange. This colouring matter differs from rosaniline, the base of magenta, in exactly the opposite direction to leucaniline, containing two atoms less of hydrogen. Leucaniline, rosaniline, and chrysaniline, are thus related:—

Leucaniline	$C_{20}H_{21}N_3$
Rosaniline	$C_{20}H_{19}N_3$
Chrysaniline	$C_{20}H_{17}N_3$

The principal use of phosphine is for the formation of a scarlet with magenta. It is not converted into magenta, nor decolourised with reducing agents or hydrocyanic acid, and, therefore, does not seem to be of the same class of colouring matters as rosaniline.

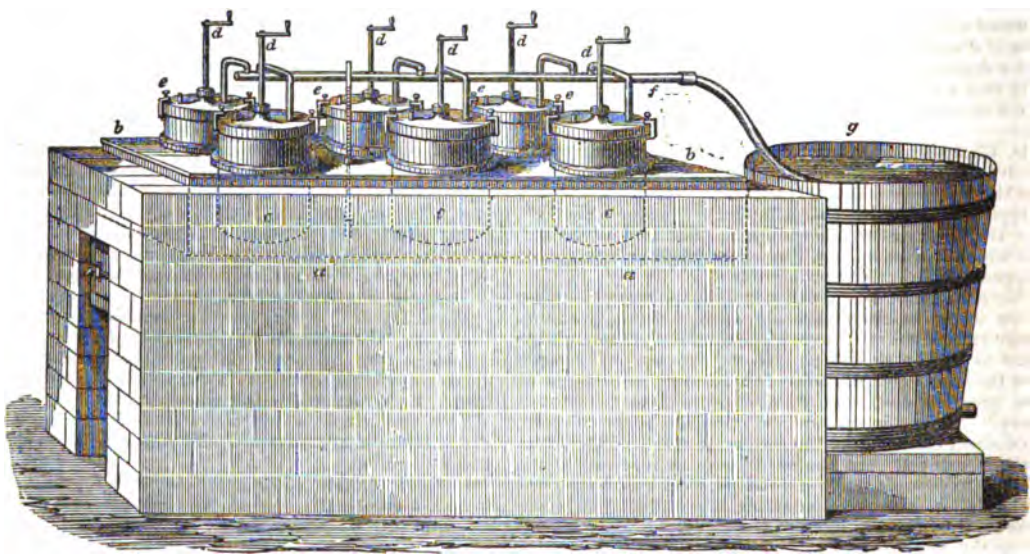
From the residues obtained in the manufacture of magenta three new colours have been obtained by Messrs. Girard and Delaire, but, I am sorry to say, my time will not allow me to enter into the particulars of these products. I believe they have not been commercially introduced as yet.

Magenta is now more used as a source of other colours than as a dye. This has caused its manufacture to be conducted on a very extensive scale, and it is now looked upon by the manufacturer as a raw material much in the same way as aniline was regarded in the early days of aniline purple.

We will next consider some of the derivatives of magenta, and the first we will study is aniline blue or bleu de Lyon. If aniline be treated with a salt of rosaniline or magenta, a remarkable change takes place; at first the colour gradually becomes purple, but afterwards gets quite blue, ammonia being evolved at the same time. This peculiar reaction was observed by MM. Girard and Delaire, who found that that this change of colour was due to the formation of a new body, which they termed the bleu de Lyon; intermediate products were likewise obtained, to which we shall refer presently. MM. Girard and Delaire patented their process in January, 1861. This new aniline blue is one of the most important of the artificial colouring matters, and its manufacture has been very much improved upon since its discovery. There are several circumstances which materially influence the beauty of its tint, such as the quality of the aniline and the particular salt of rosaniline employed in its manufacture. It is found by experience that the aniline should be as pure and free from toluidine as possible, and that the salt of rosaniline should contain a feeble acid, such as the acetate, valerate, oleate, or benzoate; but why the latter is necessary chemists are unable to understand at present. Practically, the various salts of rosaniline required for the manufacture of the blue are not prepared separately, but are produced in the operation by double decomposition, which is simply a process of exchange; thus, if acetate of rosaniline is required, a mixture of hydrochlorate of rosaniline and acetate of sodium is employed; these react on each other, and change into acetate of rosaniline and chloride of sodium.

On the large scale, the process of making aniline blue is carried out in various ways, but many employ the apparatus shown in fig. 6. This apparatus consists of an

Fig. 6.



oil bath, *a*, set in a brick furnace; it has a cover, *b*, perforated with large holes; into these holes are placed small enamelled cast-iron pots, *c*, provided with a flange, on which they rest. These pots will hold from three to five gallons, and are fitted with lids held down with clamps; each lid is provided with a small stuffing-box, through which the rod of a stirrer, *d*, passes. In the lid are also two other perforations; one of these is fitted with a wooden plug, *e*, for the purpose of testing the progress of the operation; the other is connected with a bent, movable tube, *f*, united to a long central main, to collect any aniline vapour which passes over. This main is connected at one end with a worm, *g*, to condense the vapours. The oil bath by which these pots are heated is provided with a thermometer, so that the temperature may be properly regulated. In preparing the blue a mixture of magenta, acetate of sodium and aniline is introduced into the pots, the aniline being employed in excess. When charged, the oil-bath is heated up to 190° C., and kept near that temperature. At first the red colour of the mixture changes slowly, but afterwards with rapidity. The progress of the operation is ascertained by removing the wooden plug, and withdrawing a small quantity of the product upon the end of an iron or glass rod, and it is considered complete when a good blue colour has been obtained; to ascertain this point with precision, considerable experience is necessary. The excess of aniline distils during this operation, and is condensed by the worm, and collected into a suitable receiver, so that it may be used again.

From the crude blue product thus obtained, which is a fluid of the consistency of treacle, all the different qualities of blues found in the market are prepared. The cheaper qualities are obtained by simply treating the crude product several times with hydrochloric acid. This removes all the free aniline, and most of the red and purple impurities. Another similar but more effective process is employed for the preparation of the better qualities, and consists in mixing the crude product with methylated spirits of wine, and pouring it into water acidulated with hydrochloric acid, and then thoroughly washing the colouring matter, which it precipitates with water. But for the purest kinds of blue there are several processes employed; these are based upon the difficult solubility of some of its compounds in alcohol. In preparing these very pure qualities of blue, instead of starting with the crude product, one of the purified blues is taken.

(To be continued).

New Use for Oxygen.—We are informed by M. Widemann, who is connected with the works of the New York Oxygen Gas Company, that the use of oxygen in renewing and increasing the flow of oil in petroleum wells has been so successful that a regular trade has sprung up in oxygen gas for this purpose. The gas is injected into the wells through tubes, and, mingling with the hydrocarbon vapours, forms an explosive mixture, which, when ignited, completely opens seams which have become clogged, and thus renews the flow.—*Scientific American.*

A NEW MECHANICAL FINGER FOR THE MICROSCOPE.*

By J. ZENTMAYER.

AT the present time, when we are informed almost daily of some new scheme of gigantic magnitude, and while nothing short of connecting two worlds or two oceans, by cable, canal, or railroad, will create even a short-lived excitement, it may hardly seem profitable to call attention to a Lilliput engineering instrument, such as the *Mechanical finger*. But, on the other hand, while some far-sighted ones already fear this cutting through Isthmuses, tunnelling mountains, and mining whole kingdoms, might, before long, dangerously displace the centre of gravity of our earth, I can, at least, promise faithfully, that even if the instrument which I am about to describe is worked to its utmost capacity it will not appreciably disturb the equilibrium of our planetary system.

In the study of diatoms it has been long desired to find a substitute for the clumsy fingers of the human hand, to do the delicate work of picking up rare and valuable diatoms detected by the microscope and to transfer them to a glass slide for preservation.

Professor H. L. Smith, well-known by microscopists as the inventor of several valuable accessories to the microscope, first presented us with a very ingenious little instrument of this kind.

Messsrs. John H. B. Latrobe and George Dobbin, of Baltimore, two expert microscopists, had in use for some time one of these instruments, but found it difficult to work it; and as the instrument was exceedingly well made, this proved that its construction was too complicated to give the firmness required in picking up a shell, less than one-thousandth part of an inch in length, and of which a single ounce of ocean sand contains, sometimes, many millions. Mr. Latrobe invited me to design and construct for him an instrument for this purpose.

The instrument requires many adjustable movements, and each of these increases its liability to shake and spring. So I made it my object to utilise such movements, of a first class microscope stand as are not essential for other specific operations, as parts of the new finger. I found in the movements of a mechanical or sliding stage the main movements required in the finger, and so attached the apparatus to the mechanical stage. This gave me two of the most important movements, with a firmness and with dimensions of parts for which, otherwise, there would be no room.

This step, however, made it necessary to provide for another stage; but as there is never a higher power than a ½ employed with such an apparatus, a plain stage with some simple arrrangement to hold the slides would be found quite sufficient. Such a one was therefore arranged. The cut represents the finger attached to one of my large microscopes.

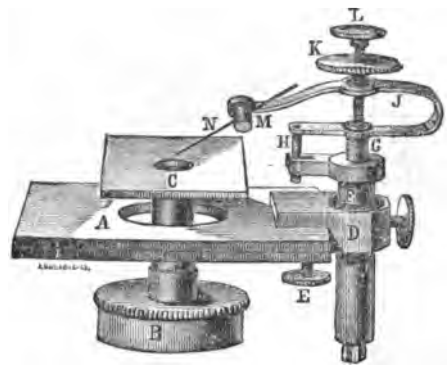
A is the top plate of the mechanical stage; the circular plate is omitted. The cap, B, is fitted to the lower body below the stage, into which cap the new substage, C, is fastened by a narrow tube, wide enough to admit illumination from the mirror. As the lower body is movable up and down by a rack, another movement is gained which is necessary to accomplish our result. The difference of the size of the aperture of the stage and the diameter of the tube, which connects the sub-stage with the cap, A, is equal to the movement of the mechanical stage, and this is found more than sufficient.

D is the clamp by which the finger is attached to the stage by means of the screw, E. A steel cylinder, G, is nicely fitted into the top and bottom of the tube, F, leaving room inside for a light spring to press the steel cylinder upwards. To prevent turning, the spring, J, is provided at H with a steel pin, accurately fitted into the fork at the top of the tube, F. By turning the nut, K, the spring, J, is elevated and depressed, giving nice adjustment to the needle, N, in case the finger is to be attached to a microscope, not having rack-movement to the cap, B, to bring the end of the hair and the object in close approximation.

The end of the spring, J, forms a little ring, with a screw cut inside, into which a cork, M, is screwed to receive a needle, N, to which a hair is fastened by wrapping gum-paper around. Turning the cork facilitates the adjustment of the air to the proper inclination. A slight pressure on the button, L, brings down the hair, and the spring, inside of F, instantly lifts it again when the pressure is removed.

The tube, F, turns in the clamp, D, in order to adjust the hair and cork more conveniently, and when brought back again it is tightened by a set screw.

Complicated as it may appear, only one movement is added to the microscope stand by this instrument, the one, namely, which gives the vertical motion. When the apparatus is to be used, the material you want to select from is placed on the sub-stage, C, and focussed, then the point of the hair is approximately brought over



the selected object by means of the stage movements and turning of D; this brings the hair nearly in focus too, because it is almost in the same plane with the object. We next adjust the hair precisely over the selected shell, press down the button, L, and the shell will adhere to the hair. Now we remove the slide with the material and substitute a glass slide, moistened by breathing on it, and having brought it in proper position, briskly dip down the button, L, again and the shell will be deposited on the glass slide. As the mechanical stage has a graduated indicator, the finger may be moved along regularly, and shells may be placed at equal distances in lines. After the cover-glass is carefully placed over it, then Canada balsam may be run in by capillary attraction without disturbing the position of the shells.

Philadelphia, April, 1870.

* Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute.*

NOTICES OF BOOKS.

Report on the Quality of the Milk Supply of the Metropolitan District (New York). By C. F. CHANDLER, Ph.D., &c. New York: D. Appleton and Co. 1870.

THE paper before us, an extract from the Fourth Annual Report of the Metropolitan (New York) Board of Health, opens with a statement which proves that (in matters of what is very tersely, yet aptly, called *administration de la sureté et salubrité publique*) the City of New York is not only not behind, but greatly in advance of a great number of European cities and towns, where investigations as regards milk supply are, as yet, *in nubibus*. Dr. Chandler's Report opens with the quotation of two analyses of pure milk—viz., one by Dr. Letheby and one by Hardlen. The general and well-known properties of milk are next

briefly alluded to, and attention called to the fact that the composition of milk is affected by a variety of circumstances, among which may be mentioned the breed of the cow, her age, the age of her calf, nature of food, and time and frequency of milking. These particulars are illustrated by quotations of various analyses, made at various epochs, by MM. Vernois, Becquerel, Chevalier, and A. Müller, put down in tabulated forms. We next find the description of the methods of analysis, as follows:—

"1. The water is determined by evaporating a weighed quantity of milk, either alone, or soaked up in a known weight of pure, fine quartz sand. The residue is carefully dried at 212° F., and weighed. The loss in weight represents the water, while the residue includes all the solid constituents.

"2. The salts are determined by carefully burning off the combustible portion of the solid residue obtained by evaporation, and weighing the incombustible ash.

"3. The butter and caseine are determined by coagulating the milk with a few drops of acetic acid, boiling, washing the precipitate with water, and finally separating the butter with ether, leaving the caseine pure. On evaporating the ether, the butter is left behind, or the butter may be extracted by ether from the residue obtained by the evaporation of a quantity of milk, soaked up in sand.

"4. The sugar is generally determined by deducting the sum of the other constituents from 100. It may be directly determined by the polariscope, after the removal of the caseine and butter, or it may be determined by an alkaline solution of copper."

The adulteration of milk is briefly, but ably, summarised in the following terms:—

"Numerous substances are mentioned as having been used, or as supposed to be used, for adulterating milk. Prominent among these are—

"1. *Water.*—Adulteration of this substance is generally detected by the sp. gr. of the milk. Pure milk varies in sp. gr. from 1·023 to 1·034, water being represented by 1·000. Milk is heavier than water, on account of the caseine, sugar, and salts, which it holds in solution. Butter, on the other hand, is lighter than water, therefore the sp. gr. of milk increases with the percentage of caseine, sugar, and salts, while it diminishes with the percentages of water or butter. It is found that good milk generally has a sp. gr. of from 1·029 to 1·032. In testing milk, the lower number is selected as a fair gravity for pure milk; and whenever the gravity falls below this number the milk may be considered as containing an excess of water, and consequently poor in quality or adulterated. An instrument, called a galactometer, has been devised by Dinocourt, for the purpose of testing the quality of milk. It is simply an areometer, so graduated that 100 on the scale represents pure milk, or the gravity 1·029, while 0 represents pure water, or gravity 1·000, the space between being divided into 100 parts. The numbers on the scale represent, therefore, the percentages of pure milk.

"Skimmed milk, having been deprived of most of its butter, is heavier than whole milk. By skimming the milk before testing it with the galactometer, the error caused by the butter is eliminated. In this case, however, the mark for 100, or pure milk, must be placed lower down on the instrument, as pure milk, having a sp. gr. of 1·029, would, after being skimmed, have a gravity of about 1·033. The 100° mark for skimmed milk is, therefore, fixed at this point.

"The *lactometer* is a simple tube closed at the lower end and graduated in hundredths. It is designed to measure the quantity of cream which rises on the milk.

"By using the two instruments together, the *galactometer* and the *lactometer*, very satisfactory conclusions, with regard to the quality of the milk, can be formed. A perfectly reliable method, though more laborious, is to actually determine the percentage of water in the milk, by evaporating a weighed quantity, and carefully drying the residue at 212° F. If a milk loses more than 88 per cent of water, having less than 12 per cent of solids, it may be safely pronounced to be adulterated with water.

"2. *Chalk.*—This substance is generally supposed to be extensively used to neutralise the acidity in soured milk, and to produce thickness and opacity, thus concealing dilution with water. It is easily detected, as it is deposited on standing, and can then be recognised by its effervescing with dilute acids. I have never detected it in any sample of milk examined. In presence would also be shown in a milk analysis, by the unusual amount of ash.

"3. *Flour, starch, emulsions of almonds, or hemp-seed, &c.*, are said to be used to thicken milk and neutralise the blue colour caused by dilution. They were not found in any of our samples.

"4. *Sugar, gum, dextrin, and borax*, to increase specific gravity.

"5. *Turmeric and anatto*, to hide the blue colour.

"6. *Cerebral matter, sheep's brains*, to thicken watered milk, easily detected by the microscope, and by its depositing a peculiar white sediment on standing.

"7. *Carbonate or bicarbonate of soda*, to neutralise acidity. Detected by the increase in the quantity of ash, or, better, by the effervescence of the ash with acids."

The author next relates his researches on the milk as supplied to the inhabitants of New York. Four distinct series of analysis were made, the second series embracing 210 samples, the following determinations being made in each case:—(1) The specific gravity; (2) the percentage of pure milk, as shown by the galactometer; (3) the percentage of water; (4) the percentage of solid matter, including butter, caseine, sugar of milk, saline constituents, &c.; examination for adulterations. The results are printed in tabular form, and prove the following facts:—The sp. gr. varies from 1·010 to 1·032, averaging 1·0208; the percentage of pure milk, as shown by the galactometer, ranges from 37 to 110, averaging 72½; the percentage of water varies from 83·57 to 94·17, averaging 89·89; the percentage of solid constituents, the nutritive portion of the milk, varies from 5·83 to 16·43 per cent, averaging 10·11. No adulteration, save water, was found in a single instance.

The general conclusion arrived at by the author establishes the fact that the citizens of New York and neighbourhood receive milk free from injurious adulterations and untainted with disease, but adulterated with water to the extent that for every three quarts of pure milk there is added one quart of water. The quantity of water thus paid for as milk, at ten cents per quart, costs about 12,000 dollars a day, or 4,000,000 dollars annually. Our readers will agree with us that the ably-written paper, from which we have largely quoted, treats on a subject of great interest, not only to New York, but to the inhabitants of all large cities and towns, where the good example of the New York authorities may be advantageously followed.

Reports on the Water Supply of New York and Brooklyn. Chemical Report by C. F. Chandler, Ph.D., &c. Microscopical Report by William B. Lewis, M.D. New York: D. Appleton and Co. 1870.

This paper contains, in its first part, chiefly the tabulated results of the researches and analysis, made by Dr. Chandler, of the Croton and Ridgewood waters, as supplied to the cities above named, during a portion of last year. It appears that the Croton water contains, in 1 United States' gallon (231 cubic inches), 4·78 grains of total solid matter, while the oxygen required to oxidise the organic matter amounted to 0·0618 grains. The paper contains, also, in tabulated form, a review, showing the purity of the Croton and Ridgewood water, as compared with the waters of other American as well as European cities. Special attention is called to the presence of lead in the Croton water, derived from the leaden service-pipes and lead-lined cisterns it passes through or is kept in. A gallon

(United States) of water which had remained for six hours in the lead pipes of Dr. Chandler's residence, yielded 0·11 grains of metallic lead, a considerable portion of which was visible to the eye, in the minute white spangles of the hydrated oxycarbonate. The author states that "tin-lined," or "lead-encased block-tin" pipes, are being gradually introduced instead of the leaden pipes. These, we may observe, can be rendered perfectly safe, if, before being put down, they are internally syringed through with a strong and hot solution of any alkaline sulphide, which will very effectually convert the metal into sulphuret of lead, which, as proved by Professor Moss Pettenkofer, is not acted upon at all, even by rain or distilled water.

The able Microscopical Report, illustrated by two lithographs, shows the necessity of very effective filtration, even of otherwise pure water.

We may congratulate the citizens of New York on the care taken for their welfare by the Board of Health, and that Board for having found men who evidently are doing their utmost to promote the good health and material well-being of their fellow citizens.

CORRESPONDENCE.

SUPPOSED FORMATION OF OZONE DURING COMBUSTION.

To the Editor of the Chemical News.

SIR,—Referring to Mr. Loew's note on "The Formation of Ozone by Rapid Combustion," inserted in a recent number of the CHEMICAL NEWS, vol. xxii., p. 13, allow me to mention that, in repeating Mr. Loew's experiment, with this slight modification, that a stream of *oxygen* instead of *air* was blown through the luminous flame of a Bunsen's burner into the mouth of a glass balloon, I really found that the air in the balloon had assumed a peculiar odour, and the property of colouring blue a mixture of starch paste and kalium iodide.

Both changes are the result of the formation of a compound of *oxygen and nitrogen* (probably dinitric trioxide or nitric dioxide), *not* from the formation of *ozone*, as Mr. Loew asserts.

The gas in the balloon being shaken with a little water, this was unable to colour the kalium iodide starch; kalium hydroxide, however, shaken with the gas, caused a dark blue colouration in the mixture, *after having been acidified with dilute sulphuric acid.* It is almost unnecessary to add that I had first assured myself by a blank experiment that the iodide was sufficiently free from iodate not to cause errors.

With ferrous sulphate and strong sulphuric acid it gave the characteristic reaction of nitrates and nitrites.

So when Mr. Loew declares that he was able to "identify the formation of *ozone* by its intense odour and the common tests," he was a little rash in this conclusion.

The odour is that of the coloured compounds of oxygen and nitrogen, the presence of which was moreover proved by the *common tests.*

Unhappily till now, except perhaps thallous oxide, the known tests for ozone and nitric trioxide, &c., are "*common*" to *both.*

Still Mr. Loew's experiment is a very interesting and easy one, and will soon take its due place in the series of lecture-experiments intended to elucidate the complex phenomenon of combustion.—I am, &c.,

J. D. BOEKE, Phil. Nat. Doct.,
Teacher of Chemistry at the Hoogere Burgerschool at Alkmaar.

Leeuwarden, Holland,
July 19th, 1870.

DETERMINATION OF FERROUS OXIDE IN SUBSTANCES INSOLUBLE IN ACIDS.

To the Editor of the Chemical News.

SIR,—I have read with great interest the method of estimating ferrous oxide in silicates described by Messrs. Wilbur and Whittlesey in the CHEMICAL NEWS, vol. xxii., p. 2. The method is just what was required, and will doubtless be found equally available for the analysis of such iron slags as are not completely decomposed by hydrochloric acid. The results of the analysis of Trap A. by Mr. Wilbur are not very constant, varying from 9·37 per cent to 11·95 per cent of ferrous oxide, and I am inclined to believe the fault lies in the method of titration employed.

It has been repeatedly shown that the presence of hydrochloric acid interferes appreciably with the estimation of iron by permanganate, while it does not affect Penny's bichromate process. If the former oxidising agent be employed, the solution should be effected by means of sulphuric acid.

This source of error seems to have escaped notice almost entirely, although most distinctly pointed out in "Fresenius," and also in Sutton's "Volumetric Analysis."

Apropos of the estimation of ferrous oxide in difficultly soluble compounds, I may mention that solution may frequently be effected by heating with hydrochloric acid under pressure. I have used this method very successfully in the analysis of various titanic iron ores and sands. About a gramme of the finely powdered mineral is heated in a sealed piece of combustion tubing, half full of fuming hydrochloric acid. At first the heat of a water-bath is sufficient, but after a few hours the temperature is gradually raised to 140° or 150° C. The ore is completely decomposed in four or five hours, and after the tube has cooled the end may be broken under water, and the ferrous oxide at once estimated by bichromate.

Of course the same method will yield a solution suitable for the determination of the other constituents of the ore.—I am, &c.,

ALFRED H. ALLEN, F.C.S.

School of Chemistry,
Sheffield, July 23rd, 1870.

COMPOSITION OF CARMINE.

To the Editor of the Chemical News.

SIR,—In your review of Mr. J. W. Slater's "Manual of Colours and Dye Wares" (CHEMICAL NEWS, No. 556), Mr. Slater is severely criticised for stating that carmine is the colouring matter of cochineal in a pure state combined with alumina. You say, "It is readily soluble in ammonia, and does not contain alumina at all," implying, at the same time, that this fact was brought about by recent researches.

Permit me to say that I have been for several years engaged in working out the chemistry of carmine, and perfecting the method of its preparation on a large scale, and that, according to my experiments, carmine, although easily soluble in ammonia when pure, is an alumina compound.—I am, &c.,

HUGO MÜLLER.

[In both the French and German editions of Schützenberger's work on Dye Materials, recently published, it is said that perfectly pure carmine does not contain any alumina, and, moreover, leaves no ash on its ignition. This author also states that there are different qualities of carmine met with in commerce, and that only the more ordinary qualities contain alumina. A similar statement to the above is also contained in the "Handwörterbuch der Reinen und Angewandten Chemie, Art.

Carmin," written by J. von Liebig, and in Persoz's standard work, "De L'Impression des Tissus." The reviewer may also refer those who are interested in the subject to the mode of preparing carmine of Madame Cenette, in which (as may be learned from the detailed description of this process, in Ure's "Dictionary of Arts, &c.," 6th edition, vol. i., p. 654; and also Cooley's "Cyclopœdia of Practical Receipts," 4th edition, p. 399) no alum whatever is used; whilst the result is the production of the finest carmine of great purity. In the book reviewed, the author has not made any distinction between the different qualities of carmine and carmine lake, and speaks about carmine as if it were a well-known chemical compound of alumina, which it certainly is not. Of course, when so eminent a chemist as Dr. Müller says that alumina is an essential constituent of pure carmine, we accept the statement as correct; but, as it is a fact which was unknown to Schützenberger, Persoz, Ure, Von Liebig, as well as to Madame Cenette, a most successful manufacturer, the reviewer may, perhaps, be excused for not being acquainted with it.—THE REVIEWER.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, July 18, 1870.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Magnetic Rotatory Power of Liquids.—A. de la Rive.—The author, in a letter to M. Dumas, states that he has just finished a series of experiments on the above-named subject, the results of which will be shortly published. The first portion of this work is devoted to the description of the apparatus and processes of experimentation; the second part contains the results of the determination of the magnetic rotatory power of some liquids. As a curious anomaly, the author mentions that, taking water as unit, the coefficient of the magnetic rotatory power of monohydrated sulphuric acid, ($HOSO_3$), is 0·750, and that coefficient is, for liquid anhydrous sulphuric acid, (SO_3), equal to 1·240 at a temperature of 12°. The third part of this work is devoted to the study of the influence of the temperature on the magnetic rotatory power. In the fourth part, the author gives the results of his investigations of the magnetic rotatory power of a mixture of two liquids, as compared with that each of these liquids possesses separately. The fifth part contains the results obtained by experimenting with two isomeric liquids.

New Researches on the Electro-Capillary Action: Formation of Crystallised Oxychloride of Copper and other Analogous Compounds.—M. Becquerel.—This paper contains another instalment of the author's researches, which have occupied his attention for a series of years. The artificial formation of the oxychloride of copper in crystalline state, and exactly similar to that found in the copper mines of Peru and Chili, and known as atacamite, has taken no less than fifteen years.

Observations of the Underground Temperature in the Jardin des Plantes, at Paris, from 1864 to 1870.—A. C. Becquerel and E. Becquerel.—From this lengthy paper, we learn that, at 36 metres below the surface, the temperature is constantly 12·47°, and that at a depth of from 36 to 26 metres a very slight difference only is observed. The paper contains a lengthy series of tabulated results.

Variations of Temperature produced by the Mixing of Two Liquids.—H. Sainte-Claire Deville.—A sharp reply to the last communication on this subject by M. Jamin.

Reply to the Criticism of M. Jamin in reference to a paper published in 1860.—H. Sainte-Claire Deville.

Researches on the Action of the Chlorides of Platinum, Palladium, and Gold upon Phosphines and Arsines.—A. Cahours and H. Gal.—This lengthy memoir is divided into the following sections:—Action of bichloride of platinum upon arsines; action of chloride of palladium upon triethyl-arsine; action of sesquichloride of gold upon triethyl-arsine.

Thermical Researches on the Metallic Character of the Alloy of Palladium with Hydrogenium, and on a Voltaic Element wherein Hydrogenium is the Active Metal.—P. A. Favre.

Possibility of Obtaining Luminous Signals Visible at Great Distances.—F. Lucas.

Photographical Studies of the Sun at the Imperial Observatory at Paris.—L. Sonrel.

Decomposition of Oxalic Acid.—P. Carles.—The author describes at length, a series of experiments, the chief result of which is that a current of even an inert gas (as, for instance, hydrogen or nitrogen) decomposes, or, rather, dissociates, at 100°, a concentrated aqueous solution of oxalic acid.

Conversion of Chloral into Aldehyde by Inverse Substitution.—J. Personne.

Crystalline Compounds of Oxide of Lead and Oxide of Antimony, and of Oxide of Lead and Antimonic Acid, from the Province of Constantine (Algeria).—M. Flajolot.—The minerals just mentioned are—A compound of oxide of antimony and lead, $Sb_2O_3,2PbO$; sp. gr., 7·02; colour, smoky brown; hardness, that of carbonate of lime; soluble even in dilute hydrochloric acid, if applied in large bulk, and also in a mixture of dilute nitric and tartaric acids. The other mineral consists, in 100 parts, of—Oxide of antimony, 4·80; antimonic acid, 35·50; carbonic acid, 4·20; oxide of lead, 51·50; water, 4·0. Formula, $Sb_2O_5.PbO+CO_2PbO+2HO$. Besides these crystalline compounds, the same mineral vein, chiefly containing calamine stone, contains an amorphous ochry substance, consisting, in 100 parts, of—Antimonic acid, 63·50; sesquioxide of iron, 31·40; water, 5·10. Formula—

$$Sb_2O_5.Fe_2O_3+\tfrac{1}{2}HO.$$

These minerals occur at a distance of 60 kilometres to the south of Bône, near to a thermal spring much frequented by the Arabs, and known as Hamman-Nbaïl-Nador.

Programm der Königlichen Rheinisch-Westphälischen Polytechnische Schule zu Aachen, für den Cursus, 1870-71.

Under the above title, the director of this school (which was briefly alluded to at page 23 of our present volume), has kindly forwarded to us this volume, containing, beside some sixty pages letter-press, several tabulated forms (of which more presently); also a series of engravings representing the plans and outline of the building. From this work we abstract the following:—On November 14th, 1863, His Majesty the King of Prussia decreed that Aachen City (Aix-la-Chapelle, Charlemagne's imperial residence) should be the seat of the High Polytechnic School to be established for the Rhenish provinces and Westphalia, and on the 15th of May, 1865, the anniversary of the fiftieth year of the annexation of the Rhenish provinces to Prussia, His Majesty laid the foundation stone of the building, in the portico of which are placed the marble busts of the King and the Prince Royal. The walls of the building are made, in the first place, as far as the foundation and basement are concerned, of trachyte from the Drachenfels, near Bonn; next follows red sandstone, from the neighbourhood of Trèves; while the higher stories are executed in tufastein, from Brohl (a kind of volcanic stone). The façade of the main building is in the early Italian renaissance style, bearing the coats of arms of the city of Aix-la-Chapelle, of Rhenish Prussia, of Westphalia, and the allegorical representations of science as Minerva with the Prussian eagle and of Borussia. The building is constructed to accommodate, with ease, 500 students, and covers a surface of 28,517 square feet. The so-called aula (a large lecture-room) is ornamented with medallions bearing bas-relief busts of the following celebrated men, the names of some of whom may, however, not be well-known to our readers:—Von Dechen, Beuth, Werner, Von Liebig, Bunsen, Magnus, Dove, Karmarsch, Bessel, Schinkel, Mellin, Von Buch, Von Humboldt, Klapreth, Mitscherlich, Liebnitz, Gauss, Redtenbacher, Borsig, and Hagen. The building is heated by hot water, and contains four tanks, each of 1000 cubic feet capacity, which are filled by means of steam pumps. Water is laid on throughout the building so as to be accessible for use in every part thereof, and also to serve in case of fire. A very good clock, with large dial-plate, and striking the hours and half-hours, is placed in the portico of the building, and, by means of electricity, the laboratory clock-dial is in connection with that of the main building. The chemical laboratory is not situated in the building just alluded to, but is a building by itself, standing in the garden and behind the main school-building. This laboratory building consists of basement and two stories (it covers 7912 square feet), and is divided into two main sections, one of which is devoted to pure, the other to technical or applied chemistry. Each of these sections contains complete laboratories, fitted up with all modern requirements, and arranged so as to accommodate, beside, sixty students for practical chemistry classes and the investigations for more advanced students. The staff attached to this establishment consists of a director; 3 heads of special schools (viz., for engineering and architecture, engine construction and mechanical technology, and chemical technology and metallurgy); 17 ordinary professors; 7 extraordinary professors; 7 assistants; 4 private teachers; a general secretary and treasurer; a librarian and scientific correspondent; and, further, 1 housekeeper (*castellan*) for the main building, 1 ditto for the laboratory, 3 porters for the laboratory, 1 machinist and foreman of the workshop, 2 stokers, and a general male servant. It is quite impossible to enter into details about the lectures, or to give any adequate description of the amount even of the material means provided to aid the instruction in this noble institution. The expenses of first establishment are £80,310, and of this £7800 has been spent upon the chemical and chemico-technical portion and laboratories, over and above the expense incurred by the separate building. None

of the students will reside in the building, which is not a college, in the sense that word is usually applied; and, in order to make clear for them the courses of lectures they will have to attend, tabulated forms have been added to this volume, one of which is very ingeniously contrived, being partly printed in colours and letterpress text, and the whole so arranged that the white spaces indicate the courses to be attended to by the students of the first year, yellow second year, green third year; the fourth year for architects and engineers is red, and for mechanico-technics blue. The lectures commence at 8 a.m., and, with the exception of 1 hour's rest, continue till 6 p.m. We may not neglect to observe that the Prussian Government has provided liberally for the proper maintenance of this school, which has been planned with the view of rendering the instruction to be given readily accessible to all. The Aix-la-Chapelle and Munich Fire Insurance Company has liberally made a grant of a capital of £3000 to the school, the interest of which is to be applied to assist some few students to pursue their studies, under certain regulations. The School is to be opened on October 10th next.

Revue des Cours Scientifiques de la France et de l'Etranger, July 16, 1870.

This number does not contain any original papers on chemistry or collateral sciences, but we notice briefly—

Manufacture of Glass.—M. Bontemps.—Under the title of "Guide du Verrier, Traité Historique et Pratique de la Fabrication de Verres, Cristaux, Vitraux" (that is to say, The Glassmaker's Guide, Historical and Practical Treatise on the Manufacture of Glass, Crystal, and Sheet Glass), the author has published a large amount of information, valuable not simply for France, but also for other countries. The extent of the glass manufacture in the country just named may be inferred from the following few scraps:—The total annual production of all kinds of glass, bottles inclusive, is 177,300,000 kilos; the weight of the raw material for this production amounts to 220,260,000 kilos.; weight of fuel required, 557,500,000 kilos.; number of workmen engaged in this branch of industry, 20,000.

Cosmos, July 16, 1870.

Utilisation of the Waste Heat of Gas-Work Furnaces.—V. Meunier.—The author proposes that the waste heat shall be applied to the heating of the air which is required to keep up the combustion of the fuel intended to keep the retorts at the requisite degree of heat. This proposal may be executed in practice in various ways, but it appears that the best plan is the construction of brick chambers, wherein the products of the combustion are made to pass in a zigzag manner previous to entering the chimney-stalk, and to heat the air contained in tubes.

Painting by means of Injection.—M. Violette.—The author employs a so-called pulverisator (spray-producing machine) for the application of pigments and dyes to the surface of textile fabrics, paper, &c. The coloured liquid is projected in an impalpable spray, and made to fall on the objects to be painted or dyed, as the case may be.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, 1870.

This number contains the following original papers and memoirs:—

On Phthalyl.—E. Ador.—The author, in the first place, describes at length his experiments on the elimination of chlorine from organic combinations, by means of finely divided silver; by this means the chloride of phthalic acid has been decomposed, and phthalyl obtained as a solid substance, insoluble in water, very difficultly soluble in alcohol, ether, chloroform, and sulphide of carbon, not attacked by bromine and sulphuric acid, and sublimable at a high temperature; boiling nitric acid oxidises phthalyl, yielding phthalic and diphthalylic acid. The formula of phthalyl is—

$$C_6H_4\left\{\begin{matrix}-\text{-}CO\text{-}\text{-}CO\\ -\text{-}CO\text{-}\text{-}CO\end{matrix}\right\}C_6H_4$$

The author in this lengthy memoir enters into full details on the constitution of phthalyl and compounds derived therefrom.

Reduction of Isatine to Indigo Blue.—A. Baeyer and A. Emmerling.—The authors state that when isatine, previously pulverised, is mixed with fifty times its weight of a mixture of equal parts of terchloride of phosphorus and chloride of acetyl, to which some phosphorus is added, and this mixture is heated for several hours to from 75° to 80° in a sealed tube, and the bright green coloured liquid contained in the tube poured into a large bulk of water, next filtered, and then left standing for 24 hours in a large basin, a dark blue pulverulent substance is gradually deposited, which, being collected on a filter and washed with alcohol, yields a body in all its properties fully identical with indigo blue. The quantity so obtained varies from 10 to 20 per cent of the weight of the isatin employed. The authors enter at great length into collateral matters of interest as regards the synthesis of indigo blue; but unless we were to produce a series of complicate formulæ, we could not give any useful abstract of that portion of their paper.

Action of Solid Chloride of Cyanogen upon Benzylic Alcohol.—S. Canizzaro.—By the action of the solid chloride of cyanogen, Cy_2Cl_2, upon benzylic alcohol, the author has obtained three different substances, viz., a small quantity of a solid body crystallising in the shape of small needles, fusing at 153°, and which may be a cyanide of benzyl, but owing to the very small quantity obtained of this substance, the author could not say for certain; next another solid body, crystallising in large prismatic shaped crystals, and containing, in 100 parts—Carbon, 75·31; hydrogen, 6·15; nitrogen, 11·19; lastly, another solid body, fusing at 86°, and found to be benzyl urethan—

$$CO\left\{\begin{matrix}NH_2\\ OCyHy.\end{matrix}\right.$$

Synthesis of the Oil of Rue.—Gorup-Besanez and F. Grimm.—After referring at length to the researches made by a great number of authors for the purpose of the artificial production of the oil of rue (*Ruta graveolens*), the authors state that they succeeded in obtaining this product synthetically, by the dry dystillation of equal molecules of caprinate and acetate of lime. This is the chief point of interest in this lengthy memoir, which contains a lengthy description of the experiments and discussion on the rationale of the reactions.

Contribution to our Knowledge of Meteorites.—C. Rammelsberg.—The author describes a series of minerals, and states that, in his opinion, the true nature of meteorites can only be learned by paying attention to the composition of the minerals constituting those bodies.

Non-existence of the Chlorocyanide of Hydrogen.—A. Naumann and E. Vogt.—The authors state that while experimenting upon the dissociation of gases and vapours, they have found that the chemical compound 2CyCl.Cy·H does not exist as such, but is simply a mechanical mixture of chloride of cyanogen and hydrocyanic acid.

Action of Bromine upon Dichlorhydrine.—A. Claus.—A reply and critical review of Dr. Carius's papers on this subject, published in No. 8 of this periodical.

Action of Chloride of Sulphur upon Aniline.—A. Claus.—Only a preliminary communication.

Researches on the Ether Derivatives of the Polyatomic Alcohols and Acids.—L. Henry.—Fourth paper on this subject, containing the following sections:—On different nitric ethers, nitric ether of the ethylglycol, nitric ether of the alcohol acids.

Elementary Bodies.—C. W. Blomstrand.

Constitution of the Combinations of the Camphor Group.—H. Hlasiwetz.—Chiefly a series of very lengthy and complicated formulæ.

Contribution to our Knowledge of the Anthracen Pigments, and on the Preparation of Anthracen in Pure State.—V. Wartha.—This paper is too lengthy and too concisely written to admit of any useful abstraction.

On Azotoluol and some of the Derivatives thereof.—This memoir is divided into the following chapters:—azotoluol, azoxytoluol, hydrazotoluol, tolidin.

Basicity (Basicität) of Acids.—F. Mohr.—An exhaustive and lengthy essay.

Occurrence and Elementary Composition of Vegetable Wax.—J. König.—This memoir contains chiefly the results (in figures) of a series of experiments made with a variety of fresh and dried vegetable matters, hay, straw of various kinds of corn, &c.; also researches on the wax contained in the excrements of cattle, horses, and sheep fed with these vegetable products.

The Association for Mineral Oils at Halle on the Saale.—This body corporate desires to obtain: 1. The best information concerning the chemical means of purifying crude paraffin cakes, so that the loss of paraffin does not thereby rise above 5 per cent: 2. A contrivance whereby materials containing paraffin may be cooled down at any season of the year to at least —5°C. In reference to No. 1, among other conditions are—that are excluded from use such substances as colourless tar oils, benzine, and, generally speaking, any substances which either dissolve or alter paraffin, the operation, moreover, ought to be readily executed and suitable for working on the large scale: the paraffin should be free from smell, and be of a bluish white colour. In reference to No. 2, the contrivance ought to be such as to enable to cool down daily at least 500 cwts. in quantities of 5 cwts. at a time. The association is inclined to give two premiums, each at £750 value, for the best of the contrivances asked for, the time being fixed for the 1st of January, 1871. Apply to the Mineralöl-Verein zu Halle a. d. S. Prussia. The committee of examination consists of several parties, among whom M. A. Riebeck at Halle.

Les Mondes, July 7, 1870.

Universal Origin of the Prototype of the Measures of Length.—Dr. Rodenbach.—The author says the elbow-length of a well-developed man is the third part of the mean height of men all over the world, and that length, equal to 0·54 metre (taken three times, equal to 1·62 metres, the average height of men on the globe), has served to derive therefrom all linear measures, and from these have been derived the surface (square) and cubical measures, as well as weights, and, in later times, has become (with Assyrians, Chaldeans, and Egyptians) the basis, also, of the monetary system.

Movable Rotating Gas-Burner Producing a Helicoidal Flame.—M. C. Woestyne.—This burner, according to what is here stated, consumes gas very completely, so that no smoke or soot is ever produced, and the activity of the combustion (fed by 60 cubic metres of air = 1919·2 cubic feet per hour) both renders the light brilliant, and is a great auxiliary to ventilation.

Inclination of the Axis of the Basilica of St. Peter, at Rome.—Rev. Father Angelo Secchi, S.J.—This eminent *savant* writes to the Editor of *Les Mondes* on this subject, explaining the cause of what now

is clearly made out to have been an optical illusion (alluded to in the CHEMICAL NEWS, vol. xxii., p. 24), traced by the writer of this note to its due cause, who, however, does not fail to point out some irrregularities and eccentricities in the building alluded to, but which, as a consequence of its enormous size, are not perceptible, unless by very careful survey. The author's object in writing on this (at Rome) well-known subject is to prevent the rumour getting abroad of defects existing which impair the stability of the Basilica, which, having been thoroughly surveyed, is found as firm as a rock. M. Narducci writes also on this subject, and both letters will greatly interest builders and architects especially.

Explosion of Picric Acid Induced by Ozone.—Rev. F. Moigno.—When picric acid is introduced into a vessel containing ozone, a violent detonation instantaneously takes place, a new proof of the danger attending experiments with nitrogenous compounds containing nitrogen only loosely bound.

Curvigraph.—M. Bellanger.—A description, accompanied by woodcuts, of a very useful instrument, intended to draw upon paper all curved lines and curvilinear figures of which a certain number of points are known.

Centrifugal Mixer.—C. Woestyn.—A lengthy description of a contrivance, especially suited to operations in sugar refineries, to separate, from viscous fluids, solid and liquid matters.

Aspirating Ventilator.—Damboise-Bénard.—With woodcuts. A very ingenious contrivance for getting rid of foul air, as well as sucking fresh air in simultaneously.

Continuous Syphon, and Substitution of Syphons for Pumps in Drainage Works, &c.—M. de Lagillardais.—With woodcuts. Useful and ingeniously-made apparatus.

July 14, 1870.

Inauguration of the Kepler Monument.—On the 24th of last June, the very small Swabian town named Weildicstadt, with hardly 2000 inhabitants, was the scene of a festive gathering for the purpose of unveiling the statue of the celebrated Kepler, who was born in an humble cottage yet existing, and now known as Keplerhaus. The statue of the celebrated astronomer, executed in bronze, represents him seated on an arm-chair; in his left hand, supported by a celestial globe, he holds a scroll, upon which an ellipse is delineated; in his right hand he holds a pair of opened compasses. At the four corners of the pedestal, upon which the statue is placed, are smaller statues, representing Michel Mastin, the Tübingen professor who taught Kepler mathematics, and Nicholas Copernicus, Tycho-Brahé, and Jobst Byrg, who assisted Kepler in making astronomical instruments. On the centre of the pedestal is simply placed "Kepler"; the other sides of this portion of the monument are embellished with bas-relief representations of incidents of Kepler's life.

Journal für Praktische Chemie, No. 10, 1870.

This number contains the following original memoirs and papers:—

The Polybromides of the Tetra-Ammonium Bases.—P. C. Marquart.—Conclusion of this memoir, to which Prof. Kolbe has added a short paper on the—

Highest Capacity of Saturation (Valenz) of the Elementary Substances.

Composition of Lawrowite and Vanadiolite, a New Mineral.—R. Hermann.—After referring at some length to the history of the two minerals above-mentioned, the author says:—Lawrowite, named after a Russian mineralogist, is a substance of 3·04 sp. gr., exhibiting a grass-green colour and glassy lustre. Heated before the blowpipe-flame it fuses to a bright green-coloured glassy mass, does not lose any weight by ignition, and contains, in 100 parts:—Silica, 53·65; alumina, 2·25; protoxide of iron, 2·48; lime, 23·05; magnesia, 16·0; hypovanadic acid (VO_4+2VO_3) (*untervanadsäure*), 2·57. Vanadiolite, sp. gr. 3·36, fuses before the blowpipe-flame at the edges, forming a black slag. It is a crystalline, nearly black-coloured, body, consisting, in 100 parts, of:—Silica, 15·61; alumina, 1·10; protoxide of iron, 1·4; lime, 34·43; magnesia, 2·61; hypovanadic acid, 44·85; formula—

$$3ROSiO_4+CaO_6(VO_4+2VO_3).$$

Probable Identity of Laxmannite and Vauquelinite, and on Phosphorchromite, a New Mineral.—R. Hermann.—The first part of this memoir contains a discussion, illustrated with the results of a series of analyses made by the late Berzelius and Dr. Nordenskjöld, and here mutually compared to prove that laxmannite and vauquelinite are identically the same, both as regards their chemical composition as also their mineralogical features. As regards the phosphorchromite, this mineral has been, the author says, also confused with vauquelinite, but, since the author's analysis has proved that this mineral contains far more oxide of lead than vauquelinite, he has termed it phosphorchromite, consisting, in 100 parts, of:—Oxide of lead, 68·33; oxide of copper, 7·36; protoxide of iron, 2·80; chromic acid, 10·13; phosphoric acid, 9·94; water, 1·16; formula, $3CuO_2PO_5+5PbO_2CrO_3+3H_2O$.

On Diphenyl.—F. Pfankuch.—Preliminary notice. When phenol-potassium and benzoate of potassa are heated together, benzol and notable quantities of diphenyl are obtained, which, after having been washed with caustic soda and distilled along with aqueous vapour, may be crystallised from boiling alcohol, and thus obtained in pure state. The author continues his researches on this subject.

Formation of Crystals in the Beads of Borax and Phosphor-Salt when Formed before the Blowpipe-Flame.—G. Wunder.—A lengthy memoir on this subject, illustrated by several lithographic plates.

Archives des Sciences Physiques et Naturelles et Revue Suisse, No. 150, June 15, 1870.

This number does not contain any original papers relating to chemistry, but the following original papers, of which we quote the titles.

The Grotto of Scé, near Villeneuve (Switzerland).—H. de Saussure.—A contribution to the history of primitive man.

Note on the Meteorological Observations made on the Coast of Labrador by Moravian Missionaries.—Dr. Gautier.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, April, 1870.

This number contains the following original memoirs relating to physical and chemical sciences:—

The Place Thallium should Occupy in the Series of the Elementary Bodies.—Dr. C. Rammelsberg.—This paper has also been published in the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, from which we have before noticed it.

Relation Existing between Crystalline Form and the Chemical Constitution of Organic Compounds.—Dr. P. Groth.—A very exhaustive and lengthy memoir, full of formulæ, but not suited for any useful abstraction.

Moniteur Scientifique, No. 326, July 15, 1870.

The only original paper relating to chemistry and its applications is a lengthy report on—

Vinage.—MM. Béclard, Bergeron, Bouchardat, Gubler, and Wurtz.—By *vinage*, a word which does not admit of being translated by a single word, is understood an operation whereby, either by the addition of alcohol, or, also, of a naturally more strongly alcoholic and deeper coloured wine, some less alcoholic and otherwise less good wines are improved, or, at least, made fit to keep and rendered drinkable. This lengthy report, wherein this subject is fully discussed, winds up with a series of conclusions and propositions for the interference of the authority of Government in a matter which is not only of high importance to wine-growing, but also to all wine-consuming countries. It appears, however, that the root of the evil is partly bad cultivation of the grapes, and partly, also, a perverted taste of the public everywhere as regards the *vin au naturel*—that is to say, the properly-fermented grape-juice. The authors disapprove of the addition of alcohol, even in the shape of brandy, and especially such spirits of inferior description and quality as are often used for the purposes above alluded to.

NOTES AND QUERIES.

Analysis of Alloys.—"T. W." should not have neglected to use a magnet, to separate, by its aid, previous to beginning analytical operation, any steel particles. Instead of using a file, it is better, also, if practicable, to cut, by means of a well-tempered cold chisel, the alloy intended for analysis; and the pieces cut off may, for security's sake, to prevent adhesion of iron or steel, be well rubbed over a hard stone, or with emery paper, and next cleaned with a stiff brush.

Inflammable Liquids.—(Reply to "G. G. M.")—Professor Nicklès calls attention to the fact, that when the chloride of sulphur of commerce is mixed with sulphide of carbon wherein phosphorus has been previously dissolved, a fluid is formed, which, though emitting fumes when in contact with air, is harmless, and may be for any length of time kept in well-stoppered bottles; on addition of liquid ammonia, however, or on passing into this liquid a few bubbles of ammonia gas, a most intense combustion at once ensues. This is due to the fact that the ammonia seizes upon the chloride of sulphur, forming chloride of ammonium, whereby so much heat is set free as to cause the combustion of the sulphide of carbon and phosphorus dissolved in it.

TO CORRESPONDENTS.

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P. H. M.—The reaction has, we believe, been observed before. You should have an experiment tried on a large scale.

T. Charters White.—We are obliged for the report. Shall be glad to have further accounts of the transactions of the club.

J. Banister.—We will endeavour to give as much information on the subject as our space will allow. Single numbers of the *Bayerisches Industrie und Gewerbe Blatt* cannot be purchased in England.

Henry Watts, B.A., F.R.S.—Our publisher will send you another number.

R. Mallet, F.R.S.—We will reply by letter.

THE CHEMICAL NEWS.

VOL. XXII. No. 558.

ON THE ADULTERATION OF MILK.

By Dr. A. E. DAVIES, F.C.S., F.L.S.

THE extracts from Dr. Chandler's report on the New York milk in the last number of the CHEMICAL NEWS (vol. xxii., p. 55) raise several points of interest bearing upon the adulteration of milk. As I have devoted considerable attention to this subject, and am at present engaged on an investigation into the quality of the milk supplied in Manchester, I may perhaps be permitted to state very shortly some of my experimental results and the conclusion I have drawn from them.

As to water being the only substance which is employed for adulterating milk I perfectly agree with Dr. Chandler. Carbonate of soda and nitrate of potash are occasionally added, but only rarely, and in very small quantity. I have never met with chalk, sheep's brains, mucilage, sugar, &c., in any sample which I have analysed.

Since water, then, appears to be practically the only substance fraudulently added to milk, it is a matter of the greatest importance that we should be able to detect the presence of added water, and to estimate, at least approximately, its amount. This (at least the presence of added water) Dr. Chandler considers may be done by taking the specific gravity of the milk and by estimating the water it contains by evaporating a weighed sample to dryness. "Pure milk," he says, "varies in specific gravity from 1·023 to 1·034, water being represented by 1·000." And, again, "It is found that good milk generally has a specific gravity of from 1·029 to 1·034. In testing milk, the lower number is selected as a fair gravity for pure milk; and whenever the gravity falls much below this the milk may be considered as containing an excess of water, and consequently poor in quality or adulterated."

Now, according to my experiments, the specific gravity cannot be at all relied on as a test either of freedom from adulteration or of natural richness. I give a single example. A sample of milk of known genuineness recently analysed by me gave the following results:—Casein, 4·26; fat, 6·26; sugar, 5·13; salts, 0·60: water, 83·75; cream (by the lactometer), 17 per cent; specific gravity, 1·0246. It was, therefore, a very excellent sample, and rich in all the solid constituents of milk, especially butter, but had it been judged by its specific gravity, it would have been put down as of very inferior quality. Besides, even supposing the specific gravity to be a reliable test of quality, it gives us no indication as to whether the milk is naturally poor or has been rendered so by the addition of water, and the test, in my opinion, is therefore worthless.

As to the estimation of the amount of water by evaporation, Dr. Chandler says—"A perfectly reliable method, though more laborious, is to actually determine the percentage of water in the milk, by evaporating a weighed quantity and carefully drying the residue at 212° F. If a milk loses more than 88 per cent of water, leaving less than 12 per cent of solids, it may safely be pronounced to be adulterated."

From this view, I totally dissent; the presence of 88 per cent of water is an indication of inferior quality, but is certainly no indication whatever that water has been purposely added. In milk of known purity, examined by Dr. Voelcker, as much as 90·70 per cent of water was found; and this alone shows the untrustworthiness of Dr. Chandler's test—at least, as far as it refers to added water.

It appears to me, that what is wanted is, not a test which will simply tell us whether or not the milk contains more than the normal quantity of water, without giving any indication whether the water has or has not been added to the milk. If this were all, the estimation of the water, by evaporation, would accomplish it; but, what really is required, is a test which will show if the milk has been purposely diluted with water, and, if so, what quantity of water has been added. Such a test, I believe, we have in the specific gravity of the serum, or liquid portion of the milk, from which the caseine and fat have been removed by coagulating and straining. The gravity of this liquid I have found to be remarkably constant, ranging, in that obtained from genuine milk, from 1·026 to 1·028; and, by carefully ascertaining the specific gravity of the serum of genuine milk diluted with various quantities of water, we may obtain a standard of comparison which will enable us to say, within a few per cents, what quantity of water has been added to any sample of milk that may come under our notice.

ON THE PRODUCTION OF CERTAIN CRYSTALLINE PHOSPHATES AND ARSENIATES.

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

A GREAT many minerals occur in a natural state, which, in their chemical constitution, their crystalline form, or both combined, have not yet been artificially produced.

It seems very desirable to know, both upon chemical and geological grounds, the conditions necessary for their production, and especially in those forms which they assume in nature.

The metallic phosphates and arseniates—a group of salts which, almost without exception, are only known in the laboratory as gelatinous or pulverulent precipitates,—stand conspicuous among those native minerals, which we have hitherto been unable to obtain by artificial means in their crystalline forms.

I have recently attempted the crystallisation of some of these compounds, with a certain degree of success; and further, in the course of my experiments, I have succeeded in crystallising some phosphates, which, hitherto, have not assumed such a crystalline form, either naturally or artificially.

The process I employ is to add a soluble phosphate, or arseniate, to the solution of a salt of the metal, the phosphate or arseniate of which is required, in the manner hitherto adopted, but only in such limited quantity, that the mixed solution remains acid in its reaction, instead of alkaline, as occurs in the usual method of procedure. If the precipitate is long in appearing, it may occasionally be crystalline; if it comes at once it will be gelatinous, as usual, but in the course of a few hours—sometimes, however, a few days—it will be found crystallised throughout.

The essential features of this process are:—

1st. The maintenance of the precipitated metallic salt in its integrity, which is effected by having the surrounding solution feebly acid.

2nd. Allowing motion to the particles of these gelatinous precipitates, whereby they are amenable to the action of crystallising force; this is accomplished by keeping a little of the same phosphate in a soluble state in contact with them.

In this manner I have succeeded in crystallising the following phosphates and arseniates, which occur in this form in the natural state:—

Phosphate of Zinc,—Hopeite, $(ZnO)_3PO_5 + 5HO$.
Phosphate of Cadmium.
Arseniate of Zinc,—Kottigite.
Arseniate of Lime,—Pharmacolite.

The following crystallised phosphates and arseniates produced do not occur as such in a natural state:—

Phosphate of Lime, $CaO2HOPO_5 + 3HO$. This has the same composition as the amorphous precipitate, produced by adding a triphosphate to chloride of calcium, and then a little ammonia (the precipitate being air-dried); and it is isomorphous with the natural arseniate of lime above, *Pharmacolite*. It crystallises in the form of rhombs, and is acid to test paper.

Phosphate of Chromium contains 24 eqs. of water, and has probably the same constitution as Delvauxine, or hydrous phosphate of sesquioxide of iron, the iron being replaced by chromium; its colour is the same as that of chrome-alum, the substance used as the source of the chromium.

Phosphate of Silver. Only crystallised from its solution in acetic acid.

Phosphate of Baryta and Strontia are also easily crystallised. Those salts having formulæ attached have been analysed.

On reviewing these salts, it will be noticed that the copper, nickel, cobalt, and iron phosphates and arseniates are absent. Indeed, I have not been able to crystallise any of them in this manner; although I am aware that it has been affirmed that phosphate of nickel has been artificially crystallised. But I find that all these metallic phosphates, &c., are capable of forming double phosphates, &c., with phosphates of magnesia and ammonia. The metal may, I think, be looked upon as substituting one equivalent of magnesia in the common ammoniacal phosphate of magnesia.

I also find that phosphate of zinc forms a crystallisable compound with either phosphate of cobalt or nickel. It may be remarked here that the crystalline mineral, *Kottigite*, an impure arseniate of zinc, always contains a little of both these phosphates.

Lastly, it appears that crystalline precipitates are readily produced by contact of soluble phosphates with solutions of the metals cobalt and nickel, if a salt of ammonia is also present. These precipitates contain ammonia, in small quantity, but it appears to be as an essential element in their composition, and not a mere accidental impurity; its quantity has not yet been determined.

The inferences I would draw from these results are:—

1st. That several of the crystalline, simple, natural phosphates and arseniates have not been produced as such directly; but that, in the first instance, *compound* phosphates or arseniates have formed. Magnesia and ammonia, singly or collectively, being the other members of the term. The magnesia and ammonia being afterwards gradually substituted by the metallic oxide. A continued supply of such metallic oxide to the compound phosphate or arseniate would almost certainly effect this, the metallic phosphates and arseniates being more insoluble than the alkaline ones.

2nd. This property of some of the metallic phosphates, &c., of combining with phosphate of magnesia and ammonia to form insoluble compounds, makes it very probable that several of these natural phosphates and arseniates may contain very appreciable quantities of ammonia or magnesia. At any rate, I think, with this property manifested, it would be well to examine rigorously this class of compounds for either of these substances.

These notes are, of course, merely preliminary, there being several points of interest left undiscussed, which can only be properly represented along with the results of future investigations.

PROPERTIES AND ESTIMATION OF ALBUMEN.

IN a recent number, we alluded to a new work on Quantitative Analysis by Prof. Storer. To show our readers the complete and interesting way in which the work is done, we extract from the first sheet the article on "Albumen":—

Principle I.—Coagulability by heat.

Applications.—Estimation of albumen in alkaline solutions, such as urine and the serum of blood.

Method A.—Acidulate the solution slightly with acetic acid, and boil for several minutes. Collect the precipitate on a tared filter, wash thoroughly with warm water, and dry in a current of warm air at 110° or 115°, or, better, *in vacuo*, over sulphuric acid, until the mass ceases to lose weight. Care must be taken that the precipitate is thoroughly dried; for, as soon as the moisture has been driven from its surface, the mass acquires the consistence of horn, and forcibly retains the last portions of the water. The addition of acetic acid to the liquid is essential, in order that the albumen shall be precipitated completely; but no great excess of the acid should be employed, lest some of the albumen be dissolved by it. The precipitate thrown down from solutions thus acidulated is more flocculent, and less apt to clog the pores of the filter during the process of washing than that obtained without the addition of an acid.

To determine albumen in urine, place 50 to 100 c.c. of the clear urine (previously filtered, if need be) in a flask large enough to hold twice as much of the liquid. Heat the liquor gradually, with frequent shaking until the albumen begins to coagulate, at about 70°; then throw a couple of drops of acetic acid into the flask from the end of a glass rod, and boil the liquor as above described (Neubauer and Vogel).

Method B.—Another method of estimating albumen in urine, devised by Heller (*Heller's Archiv. für Chem. und Microsc.*, 1852, p. 266, *et seq.*), is said to afford very accurate results, in spite of being indirect:—Evaporate 10 or 15 grms. of the urine to dryness over sulphuric acid, and weigh the residue. Weigh out another quantity of the same urine in a small flask; acidulate it slightly with acetic acid; boil until all the albumen is precipitated; and, after the liquid has become cold, place the flask upon the balance, and add to it, drop by drop, water enough to replace what has evaporated. Filter the contents of the flask, and evaporate a weighed portion of the filtrate to dryness over sulphuric acid. The difference between the percentage of residue left by the original urine and that obtained from the urine after the separation of the albumen gives the proportion of the latter ingredient.

Method C.—For comparing the quantities of albumen in any two different samples of urine, Dr. John Harley has adopted the following process:—Make three small filters from the same sheet of paper; cut down the two heavier to the weight of the lightest, and mark the filters, with a pencil, A, B, and O. Take 1000 grain-measures of urine A; and, having boiled it, pour it, while hot, upon filter A. Treat urine B in a similar way. Wash the contents of each of the filters with warm water until the last traces of adhering urine have been removed. Then pour upon the albumen an ounce of water containing 2 drops of nitric acid, and subseqently wash out the acid with water. The filter marked O is placed, in the first instance, between one of the other filters and the funnel, and is thus equally saturated with urine and acid, and equally washed free from both. All three filters are dried together; and the empty filter is used as a counterpoise in determining the weight of the albumen upon the others.

Properties.—Albumen, as it occurs in the state of solution in the animal economy, is combined, not only with water, but with minute quantities of certain saline and alkaline ingredients. When a solution of pure albumen is evaporated, *in vacuo*, at temperatures below 50°, there is left a light yellow, translucent mass of soluble albumen, which may be readily rubbed to a fine white powder. When treated with water, this residue swells up to a jelly, without, however, dissolving to any very considerable extent, unless a small quantity of an alkaline salt be present. By the action of most mineral acids, and of many other chemical agents (sometimes by mere contact with atmospheric air), this soluble modification of albumen is changed to the coagulated, insoluble condition.

Insoluble albumen, when recently precipitated and still moist, is a tough, white, opaque, flocculent solid, insoluble

in water, alcohol, ether, and most acids, when dilute and cold. When left moist in the air, it putrefies. It is somewhat soluble in hot acetic, tartaric, phosphoric, and strong chlorhydric acids. When boiled for a long time with water, it decomposes and dissolves. On being dried, it assumes a yellow colour, and becomes brittle and translucent, like horn. When soaked in water, after drying, it takes up about five times its weight of the liquid, and becomes soft and elastic.

Principle II.—Opacity.

Applications.—Estimation of albumen in aqueous and saline solutions.

Method.—Prepare a little trough of sheet-iron, with glass ends, as follows:—Provide three rectangular sheets of metal, one 7 c.m. square, the others 4 c.m. long by 2·5 c.m. wide. Bend the square sheet into the form of a V-shaped gutter, the upper edges of which are 1 c.m. apart. From each of the smaller sheets cut out wedge-shaped pieces of metal corresponding to the shape of the trough, so that, when the sheets are placed in an upright position, the V-shaped trough may fit into the cuts, and be supported as by feet. Place one of these supports near each end of the trough, and solder them to the trough. Cut out two V-shaped pieces of window glass, fitted to the trough, and cement them into the ends of the trough with Canada balsam, taking care to place the glasses parallel to one another, and to leave a clear distance of 6·5 c.m. between them. The glasses can be cemented the more readily in case a notch or groove be made upon the iron in the beginning to receive them. The metal of the trough should be painted with asphaltum varnish to protect it from rust.

As applied to the estimation of albumen in urine, the process of testing is as follows:—Filter the urine, in case it is not clear, acidulate it slightly with acetic acid, if it be not already acid, and proceed to determine how much the urine must be diluted to fit it for the test. To this end prepare several dilute solutions by mixing measured portions of the urine with water and boil each of the solutions in regular order, until one is found in which the albumen no longer separates in distinct flocks, but only as a milky cloud. It is a liquid thus clouded by the presence of fine particles of suspended albumen, which admits of being subjected to the test of opacity.

The best way of preparing these dilute solutions is the following:—By means of a little pipette graduated to 0·1 c.c., take up 6 c.c. of the urine and transfer it to a 100 c.c. flask. Fill the flask with water to the mark, shake the mixture thoroughly, pour the liquid into a beaker and leave the flask inverted in order that it may drain. Meanwhile pour 6 or 8 c.c. of the diluted urine into a test-tube of 20 or 25 c.c. capacity, heat the liquid to boiling, and afterwards cool it quickly by immersing the tube in cold water. In case the precipitate produced by boiling is so slight that the form of objects placed in strong daylight can be distinguished on looking at them through the liquid, the sample has been too much diluted, and the operator will at once proceed to prepare a more concentrated solution by mixing 12 c.c. of the original urine with water in the 100 c.c. flask. But in case the first solution was not transparent, it may be tested in the trough.

In testing, fill the trough two-thirds full of the cold boiled liquid, and look through the liquid at the flame of a burning candle in a darkened room. Repeat the experiment with other diluted samples of the urine until a point is reached where the shape of the flame cannot be distinguished, and only diffused light can be seen through the liquid, even when the candle is brought close to the trough.

In case the flame is visible through the first solution, the next trial must be made with a solution containing a few more per cents of urine than the first. But if the shape of the flame cannot be distinguished, the liquor of the subsequent trial must be more dilute, and so on methodically, until a liquid is obtained through which the reddish yellow cone of flame can only be seen by looking with the strictest attention, as if it were in a thick fog. When this point is reached it is only necessary to add a trace more urine (0·1 or 0·2 per cent) in preparing the next diluted sample, in order that the flame may become completely invisible, and the operation be finished.

To find the percentage of albumen, divide the number 2·3553 by the number of c.c. of urine taken to prepare the dilute solution through which the flame could no longer be seen. This number 2·3553, is the mean of 35 experiments by Dragendorff, in which the results of the optical test were controlled by precipitating and weighing the albumen.

Precautions.—In looking at the flame, the trough should be held before the eye like a spy-glass, and moved forwards and backwards from a distance of 0·5 metre from the candle close up to the flame, while the instrument itself is continually pressed lightly against the eyebrow. Up to a certain point the last glimpses of the cone of flame can be seen more readily, in proportion as the trough is closer to the candle, but if the flame is too near the liquid, the latter is illuminated by a reddish yellow light, through which the flame is seen less readily. The chamber in which the operation is conducted, should always be dark enough that the yellow light of the candle may overpower the daylight.

In case albumen separates from a diluted liquor in small flocks, the liquor may often be made cloudy and fit to be tested by shaking it violently as soon as the flocks appear. Densely clouded liquids, on the other hand, may be used for preliminary, approximative tests, by mixing them with measured quantities of water. But the results of such experiments must always be controlled by testing samples of urine which have been diluted before boiling. Better results can always be obtained by boiling weak solutions of albumen than by boiling comparatively strong solutions and mixing the cloudy liquor with water.

Instead of the 100 c.c. flask above prescribed, a 50 c.c. flask may be used, but rather more accurate results can be obtained when the larger volume of liquid is operated upon. The pipette employed must be graduated to 0·1 c.c. so that quantities of liquid as small as 0·05 can be measured with it.

The chief difficulty of the process is found in endeavouring to properly acidulate the original urine. Many samples of albuminous urine yield no precipitate, or only a comparatively feeble precipitate on boiling, when too strongly acidulated with acetic acid, and, in like manner, less albumen is obtained by the optical test than by the method of precipitation, in case the acid reaction of the urine is indistinct. It is important that the urine should be kept in a cool place, in order that it may be as fresh as possible when tested.

The original urine need not be filtered unless it contains a distinct precipitate. Urine that is merely cloudy will usually become clear when mixed with much water. Some samples of albuminous urine, however, become cloudy when treated with a few drops of acetic acid or with five or ten times their volume of pure water, and it is precisely this kind of urine which is least readily tested by the optical method. Special care must be exercised in adding acid to such urine, since the presence of a trace of acetic acid in excess may present the appearance of any precipitate on boiling. The cloudy solution (paralbumen) produced on mixing the urine with water, need not be filtered. The mixture should be boiled at once, as if it were clear.

The process is easy of execution, and is said to yield very accurate results, excepting perhaps those kinds of urine which become cloudy on the addition of acetic acid. Ordinarily, no more than five or six of the diluted samples of liquid have to be tested in order to hit the point of obscuration, so that the determination will be finished in the course of half an hour.

The several experiments of the series above mentioned agreed with one another in most instances to the second

decimal place. Only three experiments out of the thirty-five differed more than 0·1, and only 11 more than 0·05, so that 21 of the trials agreed to 0·05 per cent. (Alfred Vogel, *Zeitsch. analyt. Chem.*, 1868, vol. vii., p. 152).

Principle III.—Power of rotating the plane of vibration of a ray of polarised light.

Applications.—Estimation of albumen in aqueous or saline solutions, such as urine and the serum of blood.

Method.—When a ray of polarised light is made to pass through a column of albumen solution enclosed in a tube, it is found that the plane of polarisation is rotated to the left, and that the angle of deviation is proportional to the length of the column of liquid. In like manner, when a tube of any given length is successively filled with solutions containing different quantities of albumen, the angle of deviation is found to be proportional to the amount of albumen in the liquid.

An apparatus, known as Soleil's Albuminimeter, used for measuring the rotatory power of albumen, resembles the ordinary Saccharimeter, with the exception that, in place of the Nicol's prism there used as the analyser, a double refracting prism is employed, cut in such manner that only a single image shall appear in the field of vision. An intense white light, such, for example, as that of a petroleum lamp, is needed. The lamp is placed in a blackened box provided with a reflector, which throws the rays of light upon a movable lens, by which they are concentrated before reaching the apparatus.

After the lamp has been lighted and placed in front of the apparatus, put a piece of red glass in front of the polarising prism in the path of the luminous rays, and turn the analysing prism until the luminous image has completely disappeared. The zero point of the apparatus having thus been determined, fill the tube with the solution to be tested, place it in the apparatus, and leave the liquid at rest during some minutes. On again looking into the apparatus it will be seen that, by virtue of the rotatory power of the liquid in the tube, the luminous ray has again become visible, and it will be found that the index of the apparatus must be turned through a certain number of degrees in order to again extinguish the ray. But by counting the number of degrees and minutes between the two points of extinction, it is easy to determine the amount of the rotation and to estimate therefrom the proportion of albumen in the liquor.

It is important to exclude external light as completely as possible; to make several observations with each sample of liquid, and to read the divisions of the circle and vernier carefully, best with a good lens.

In case serum of blood is to be tested, about 1 grm. of sulphate of sodium should be added to each 100 grms. of the liquid, and the mixture filtered immediately, in order to separate blood globules and other suspended particles. The purpose of the sulphate is merely to facilitate the filtration; in the case of urine none of it need be added. The yellowish orange colour exhibited by serum when viewed in thin layers, becomes distinctly red when seen in a long column like that in the tube of the albuminimeter. In general, however, this colouration is not intense enough to do any harm; it simply obviates the need of using the red glass, for, like the latter, it only permits the passage of red rays.

In a series of fifty experiments upon blood serum, Becquerel found that the deviation of the plane of polarisation varied between 4° 30′ and 9°, or, on the average, 7° 30′. In general, the deviation oscillated between 7° and 8°. The corresponding quantities of pure dry albumen were from 4·86 to 9·44 per cent. From these and like observations, it has been calculated that, with a column of liquid 20 c.m. long, each minute of deviation corresponds to 0·18 grm. of albumen. (Becquerel, in Robin and Verdeil's *Chimie Anatomique*, 1853, iii., 316.)

Principle IV. Specific Gravity.

Applications.—Estimation of albumen in urine.

Method.—Take the specific gravity of the urine and note the temperature of the liquid when the observation is made. Acidulate a quantity of the urine with acetic acid, place the liquid in a flask provided with a perforated cork carrying a vertical glass tube, and boil it until all the albumen has separated in the insoluble state. Cool the boiled urine to the temperature at which the specific gravity of the original urine was determined, and take the specific gravity of the clear filtrate. Multiply the difference between the two specific gravities by 210, in order to obtain the percentage of albumen in the sample. In a series of thirteen experiments, the least error was 0·005, and the greatest 0·056. (Lang and Haebler, *Zeitsch. analyt. Chem.*, 1868, vii., pp. 513, 514.)

An article on the estimation of albumen, by gramimetric and volumetric methods, has been published by C. Boedeker, in Henle and Pfeufer's *Zeitschrift für rationelle Medicin*, Zurich, 1859, v., 320.

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

(Continued from p. 54).

Aniline-blue, or "bleu de Lyon," is supplied to consumers as a coarse powder having a coppery lustre, or in alcoholic solutions; it is nearly insoluble in water, and has to be dissolved in alcohol before it is added to the dye bath.

The nature of this blue has been determined by Dr. Hofmann. It is found to contain, like magenta, a colourless base, becoming blue only upon combining with acids. Dr. Hofmann has shown this base to contain $C_{38}H_{31}N_3$, and has called it "triphenylrosaniline." Like rosaniline, it becomes colourless when treated with nascent hydrogen, forming a new base, giving colourless salts, as leucaniline. The composition is $C_{38}H_{33}N_3$.

The insolubility of aniline blue in water has been found a great drawback to its use, because when employed for dyeing it is thrown out of solution in the dye bath, and then mechanically adheres to the goods, so that it afterwards rubs off.

Mr. Nicholson has, however, discovered a process for rendering this blue perfectly soluble in water. His process closely corresponds to that employed to render indigo permanently soluble. This, it will be remembered, is effected by subjecting indigo to the action of concentrated sulphuric acid, whereby a sulpho-acid is produced.

Mr. Nicholson has found that aniline blue, when treated by a similar process, also forms a sulpho-acid, perfectly soluble in water, and forming with alkalies nearly colourless solutions. These, however, when decomposed by acids, change back to the original blue.

This soluble blue is now much used for silk dyeing, but by dyers it is not thought to be so fast as the normal compound. By some modification of the process just described, Mr. Nicholson has obtained another soluble blue, commercially know as "Nicholson's blue." This is now very extensively employed in Great Britain for wool dyeing, but its application does not appear to be well understood in France and Germany, so that its use there is not so great as in our own country.

If a salt of rosaniline and aniline be heated together, and the process stopped before aniline blue is produced, the resulting product when treated with dilute acid gives a colouring matter which has been called "violet imperial." This was at first supposed to consist of a mixture of blue and magenta, but recent research has shown it to consist of intermediate products. Very large quantities of this colouring matter have been used, but its consumption is now rapidly falling off, owing to the introduction of new violets, about to be described. A few months after the discovery of aniline blue, another colouring matter, called the "bleu de Paris," was obtained by MM. Persoz, De

* The Cantor lectures, delivered before the Society of Arts.

Luynes, and Salvetat. These chemists found that when aniline was treated with tetrachloride of tin for thirty hours to 180° C. in a sealed tube, neither a red nor a violet, but a very pure blue was produced. This colouring matter is generally described as being identical, or probably identical, with the bleu de Lyon. These blues are, however, widely different in their chemical nature, as the bleu de Paris is easily soluble in water, and crystallises freely in needles of a blue colour, with a coppery reflection. It consists of the hydrochlorate of an organic base, which is precipitated from its solution by alkalies as a purplish blue powder; it dyes silk readily, and retains its blue colour by artificial light. It is remarkable that the discoverers of the bleu de Paris do not seem to have observed its difference from the bleu de Lyon.

I have prepared some of this product with a view to its examination, but hitherto have been prevented from determining its composition. I hope to do so soon.

The bleu de Paris is, unfortunately, difficult to prepare in large quantities, and has never been introduced commercially.

The recognition of the nature of the bleu de Lyon, by Dr. Hofmann, led him to study the action of a class of substances upon rosaniline, known to chemists as the iodides of the organic radicals; this investigation resulted in the discovery of the brilliant colours known as the Hofmann violets, and of which so many shades can be obtained, from a very red purple to a nearly pure blue.

The substances generally used for the preparation of the Hofmann violets from rosaniline are the iodides of methyl and ethyl; the iodide of methyl differs from that of ethyl in a practical point of view, in being rather quicker in its action; it is also more volatile. Both these substances contain a remarkable element called iodine. This body is found in sea-water and sea-weed; its aspect is very similar to that of a metal; one of its characteristic properties is that, when heated, it volatilises and produces a beautiful purple coloured vapour, and here we find how dangerous a little knowledge is when relied upon. When the iodide of ethyl, which, as I have told you, contains iodine, was introduced for the preparation of the Hofmann violets, it was stated in some of our periodicals or daily papers, I do not remember which, that chemists had at last succeeded in fixing the colour of iodine, whereas, the iodine has nothing whatever to do with the colours produced with the iodides of ethyl and methyl, but is simply an instrument in bringing about the change which takes place in their formation; moreover, these colours can be equally produced without using iodine at all. It is unfortunate that the popular reports upon scientific matters are generally so utterly untrustworthy. One of the most remarkable reactions of iodine is the blue violet colour it gives with a solution of starch; this is used as a test for its presence when in the free condition, and is remarkably delicate; it is of no use as a colour, as it is instantly decomposed when heated. To prepare iodide of ethyl, ordinary alcohol is treated with iodine and phosphorus; the operation has to be conducted with care, as iodine reacts upon phosphorus with great energy; usually the alcohol and phosphorus are placed in a retort, and the iodine added very carefully, and in small quantities at the time. The mixture is then distilled, and the distillate mixed with water, which causes the iodide of ethyl to separate as a colourless heavy oil. Iodide of ethyl is very volatile, boiling at 70° C.; it has an ethereal odour, and when pure is colourless and transparent; it contains no less than 81 per cent of iodine. Iodide of methyl is prepared in exactly the same manner as that of ethyl, substituting wood naphtha, or methylic alcohol, for ordinary alcohol; it contains a still larger quantity of iodine than the iodide of ethyl, viz., 89 per cent.

For the preparation of these substances on the large scale, special apparatus has been devised, and sometimes amorphous or red phosphorus is substituted for the ordinary kind; but I shall not have time to enter more fully into this subject. To produce the violets, Dr. Hofmann heats pure rosaniline with iodide of ethyl, or methyl and methylated spirits of wine, in a cast-iron digester, closed air-tight, with a lid fastened down with screws. A process very similar to this is sometimes employed, and consists in using a salt of rosaniline, caustic alkali, iodide of ethyl, and alcohol. But in Germany the ordinary hydrochlorate of rosaniline is employed with alcohol, or wood spirit and iodide of ethyl, and is found to work very successfully. By employing the rosaniline itself a lower temperature is required for the formation of violet than when using its salts; in fact, I have found that a mixture of iodide of ethyl and rosaniline react even at the ordinary temperature if left in contact for a few days, and produce a red shade of violet.

On the large scale, Hofmann's violet is generally prepared in deep cast-iron vessels, surrounded with a steam jacket, and provided with a lid having a perforation, closed with a screw plug. This lid can be firmly fastened down with screws, the joint being made with a vulcanised india-rubber washer. This apparatus is charged with a mixture of hydrochlorate of rosaniline dissolved in alcohol or wood spirit, and iodide of ethyl or methyl, in proportion according to the shade required. After the apparatus is closed the steam is allowed to enter the steam jacket, and the heating continued for five or six hours; the plug is then removed from the lid of the apparatus, and the alcohol or unused iodide of ethyl distilled off. The resulting product is dissolved in water, filtered, and precipitated with chloride of sodium, but sometimes it is first treated with caustic alkali, to remove all the iodine, so that it may be recovered. Thus obtained, the colouring matter is of a golden lustre if of a blue shade, and of a greenish if of a red shade.

Like all the other colours we have considered, the Hofmann violets are nearly white organic bases, their composition differing according to the shade of colour, thus:—

A red shade is composed of ..	$C_{22}H_{23}N_3$
A red violet shade of	$C_{24}H_{27}N_3$
A very blue shade	$C_{26}H_{31}N_3$

The colours of the Hofmann violets are remarkable for their brilliancy, but, unfortunately, they do not resist the action of light so well as might be desired; it is remarkable, however, that the regard for fastness seems to have given way to the desire for brilliancy.

In the early days of coal-tar colours fastness was so much talked about, that when magenta was first introduced it was thought by some that it would not be largely used—how different has it proved to be. Although not very fast upon cotton, the Hofmann violets are sufficiently so for woollen and silk goods, as colours always resist the light better when applied to animal fibres.

In the formation of Hofmann violets we see that rosaniline, when treated with iodide of ethyl, becomes blue, the red being converted into violet; but with mauveine, the base of the mauve, exactly the reverse takes place, the mauveine being converted into a much redder shade with iodide of ethyl. The colouring matter produced from mauveine and iodide of ethyl is commercially known as "dahlia;" the colour is intermediate in shade between aniline purple and magenta. This colouring matter possesses the same character for fastness as the mauve, and also gives the same reactions with acids; unfortunately it is rather expensive, and has, therefore, not been very extensively used.

Lastly, there has been a process proposed for the production of colouring-matters similar to the Hofmann violets, by first converting the aniline into ethylaniline, a base previously discovered by Dr. Hofmann. It is found that by substituting this base for aniline, in some of the processes which have been employed for the manufacture of magenta, the ethyl-aniline yields purple or violet colouring-matters.

This process has been patented by MM. Poirier and Chappat, but the reaction appears to have been first observed by M. E. Kopp. From the great similarity of these colouring matters to the Hofmann violets, I need not enter into any lengthened description of their properties.

Sea-water contains, besides iodine, another remarkable element called bromine; it is a liquid giving off very irritating orange-coloured vapours. This remarkable body yields, with many hydro-carbons, a great variety of compounds. With ordinary turpentine, it acts with great violence; but if the action be moderated by the presence of a large quantity of water, a thick viscid oil is obtained. This body was examined by Mr. C. Greville Williams, who found it to possess the formula—$C_{10}H_{15}Br_3$.

I have found that this substance, when heated with a solution of magenta in methylated spirits, produces a purple colouring matter of great beauty, commonly known as the Britannia violet; it is very extensively employed for dyeing and printing, and can be produced of any shade, from purple to a blue violet.

The Britannia violet possesses the golden green lustre so common to all the aniline colours. It is easily fusible, amorphous, and very soluble in water.

In my last lecture I showed you the great intensity of the mauve dye. I will now make a few experiments to illustrate the great intensity of some of the colouring matters we have been considering this evening.

I have here some screens of white paper, on which I have dusted a very small quantity of the solid colouring matters,—so small a quantity that I dare say you can scarcely discover its presence. If I now project spirits of wine upon these screens, so as to dissolve the colours, you will see their remarkable intensity.

Let us now consider for a moment the great rapidity with which the discovery of new coal-tar colours followed that of the mauve or aniline purple.

Aniline purple was discovered in 1856; three years afterwards, in 1859, the magenta was introduced. In 1861 we had the aniline blue; in 1863 the Hofmann violet; and in 1865 the Britannia violet. Thus we see that all these colours have not only been discovered, but introduced commercially, in a period of less than ten years.

We have now reviewed the principal coal-tar colours, but there still remain some important ones for our consideration next lecture; and although some of these are not at present largely used, yet it is to them, perhaps, that we may look for the future development of this branch of industry.

(To be continued).

BURETTE FOR VOLUMETRIC ANALYSIS.*

By J. BLODGET BRITTON.

There has been in constant use, for the last four years, at the Iron Masters' Laboratory, in determining iron in metals and ores, a very convenient and serviceable burette.

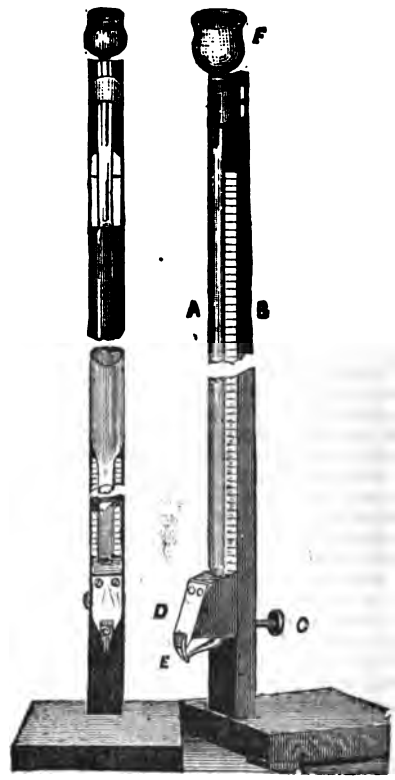
Figures 1 and 2 represent two of the kind, but of different patterns, mounted on walnut wood stands; the former is for metals, and the latter, of smaller capacity, for ores.

Securely fastened to the upright, B, is a graduated tube, A, having its lower part drawn out in the usual manner, but bent outwards at an angle of about 25°. E is a piece of cork rivetted into a sheet-steel spring, D, which presses tightly, by means of the latter, against the vent of the tube. C is a thumb-screw passing through the frame and bearing against the spring.

The tube of Fig. 2 has a capacity of 100 c.c. and is graduated into tenths, or 1000°; but that of Fig. 1 has a capacity of 150 c.c. and is graduated into 20ths, though only at its lower and narrow part.

Modes of Operating.—Place a small narrow-necked funnel in the tube as shown by the figures; pour in the solution to be used until it quite reaches the funnel, and then remove the latter to carry away any floating bubbles; turn the thumbscrew and bring the top line of the solution exactly to the 0 line of the scale; stop the flow, and afterwards touch the point of the cork with a glass rod to take from it any adhering drop. The instrument is then ready

Fig. 1. Fig. 2



for use. By means of the thumbscrew the dropping may be controlled with *extreme nicety* or *instantly* stopped. Cork, after a little use, becomes quite inert towards permanganate of potash. The occasional application of some pure tallow to the end of the tube and cork will be quite effectual in preventing any of the fluid from running upwards by capillary attraction.

For every day use in the laboratory, as well as for very accurate determinations, I think this burette will find favour.

* Communicated by Prof. Morton. From advance-sheets of the *Journal of the Franklin Institute.*

University of London (First B.Sc. Examination).—The following are lists of the candidates who have passed the recent examinations:—*Pass Examination*: First Division—Philip Herbert Carpenter, University College and Royal School of Mines; Thomas Hick, B.A., private study; John Landor Lowe, King's College; Leonard Lyell, University College; Bernard Mathias Simon Roth, University College; Robert Forsyth Scott, University College. Second Division—Charles Stuart McLean, B.A., Wesleyan College, Taunton; James Monckman, private study; Henry Elthington Price, University and Regent's Park Colleges; William Watson Rowland, B.A., University College.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor Tyndall, LL.D., F.R.S.

(Continued from vol. xxi., p. 272).

Electro-Chemistry.—Chemical Actions in the Voltaic Cell: Origin of the Current.

188. Philosophers suppose matter to be made of elementary parts, called atoms, which are practically indivisible.

189. The elementary atoms can be caused to unite to form compound atoms, which are called molecules.

190. Thus, water is formed of the combination of the atoms of oxygen and hydrogen; common salt is formed of union of atoms of chlorine and sodium; potash is formed by the union of the atoms of potassium and oxygen; the sulphuric acid, also, which we employed to acidulate our water is formed by the union of atoms of sulphur with atoms of oxygen.

191. When, as in our first experiment, two strips of zinc and platinum are dipped into acidulated water, the zinc, as we know, exerts a very strong attraction on the oxygen of the water. When the strips are united, this attraction triumphs; the oxygen unites with the zinc, and a voltaic current is established.

192. The oxide of zinc here formed combines with the sulphuric acid and forms sulphate of zinc.

193. By this removal of the oxide from its surface, the zinc is kept constantly clean, and thus enabled to attract other atoms of oxygen from the surrounding liquid. During this process the zinc gradually dissolves, and as long as this continues the electric current will flow. In fact, it is the constant dissolution of the zinc that maintains the permanent current.

194. The hydrogen of the water, as we have seen, escapes as a free gas from the surface of the platinum, which, unlike the zinc, is not dissolved.

195. We are not yet quite clear as to the precise way in which the electric current is supported by the solution of the zinc, but the following facts and speculations ought to be known to you.

196. When two different metals are brought into contact, with no liquid between them, one of them charges itself with positive and the other with negative electricity. We have here the famous "contact force" which Volta and his followers considered to be the urging power of the voltaic current.

197. But the generation of heat, and the performance of mechanical work, by the mere contact of two metals, would be equivalent to a perpetual motion. It would be at variance with the law which requires, for the production of any power, an equivalent consumption of some other power.

198. It is, however, a fact, that, when two different metals touch each other, the positive electricity resorts, by preference, to one metal, and the negative electricity to the other; the two electricities are, as it were, attracted differently by the two metals.

199. This difference of attraction, however, only causes a momentary re-arrangement of the two electricities, which pass, when the contact is made, into a new condition of equilibrium. As long as the contact continues, this equilibrium is not disturbed; there is no continuous current.

200. We may regard the distinct atoms which enter into the molecules of a compound as charged in a similar manner. For example, the atoms of hydrogen and oxygen, when they unite to form a molecule of water, may be looked upon as charged like the two touching metals. This would be the case if the atoms, like the metals, possessed different attractions for the two electricities.

201. When strips of zinc and platinum are plunged in such a liquid, the positively-charged atom will turn towards the one metal, and the negatively-charged atom towards the other.

202. But, unless the metals touch each other, electrical equilibrium immediately sets in, a constant state of electric tension being set up at the free ends of the two metals.

203. The electricity at the ends may be permitted to flow into a condenser, and may be thus stored up; such a condenser may then be discharged through a covered wire which passes round a magnetic needle, a deflection of the needle being thus produced.

204. Thus, in Davy's experiment with his large voltaic battery, wherewith he charged his battery of Leyden jars, the latter, after having been charged, might be discharged through a galvanometer, a magnetic deflection being thus produced.

205. But the metals, once relieved of their charge, would immediately re-load themselves with electricity, and might be again employed to charge a Leyden battery, and to produce a deflection of a magnetic needle.

206. At no moment during this process the battery circuit would be complete; still we should have a succession of magnetic actions similar to those observed with a closed circuit.

207. In fact, in the closed circuit the solution of the zinc incessantly removes the charged surface of that metal by dissolving it away, and enables the zinc to take a fresh charge; an incessant effort, never fully satisfied, is made to establish electric equilibrium; the incessant renewal of the effort maintains the electric current.

Chemical Actions at a Distance: Electrolysis.

208. Thus, then, in the cell where the voltaic current is generated chemical action occurs. We have, on the one hand, the decomposition of the water, and on the other the combination of the zinc with the oxygen and the sulphuric acid.

209. But a voltaic current can also produce chemical action at a distance from its place of generation. This discovery, as stated in Note 127, was made in the year 1800, by Nicholson and Carlisle.

210. We cannot decompose water by a single voltaic cell; but, when two or more cells are united to form a battery, the current from such a battery, when sent through acidulated water, tears asunder the united atoms of oxygen and hydrogen.

211. The oxygen is set free at the place where the current enters; the hydrogen is set free at the place where the current quits the liquid. If the direction of the current be reversed, the oxygen and hydrogen instantly change places.

212. It must be clearly borne in mind that the direction of the current, as already defined, is the direction in which the positive electricity moves. Knowing, therefore, the places at which the oxygen and hydrogen are liberated, we can infer with certainty the direction of the current through the liquid.

213. For every volume of oxygen liberated in the decomposition of water by a voltaic current, two volumes of hydrogen are set free.

214. Electro-chemical decomposition is called *electrolysis*; and the compound liquid decomposed by the electric current is called an *electrolyte*.

215. The electric current formed a powerful means of analysis in the famous experiments of Sir Humphry Davy, in 1807.

216. By operating with the current upon ordinary potash, Davy found the base of this substance to be a metal of exceeding lightness, and with an extraordinary appetite for oxygen. When placed on water, it floated on the liquid, and combined with its oxygen. By the heat thus generated, the liberated hydrogen was caused to burst into flame. When a globule of the metal was placed on ice, it burned with a bright flame, and the hole made by the heat was filled with a solution of potash.

217. Soda, treated in the same manner, also yielded a metal resembling that of potash. Thus Davy, by the use of the voltaic current, decomposed the alkaline earths, and greatly expanded our knowledge of chemistry.

218. To obtain these effects, it is necessary to bring the potash and the soda to a state of fusion by heat. In the solid state they are non-conductors of electricity. In fact, the molecules, when rigid, cannot turn in the manner indicated in Note 201. To conduct the current, it is necessary that they should thus turn and be decomposed.

219. When a current is sent through a solution of common salt, it decomposes both the water and the salt. The chlorine of the salt, in company with the oxygen of the water, appears where the current enters the liquid. The sodium of the salt, in company with the hydrogen of the water, appears where the current quits the liquid.

220. Chlorine possesses powerful bleaching properties; and, if the solution of salt be coloured with indigo or litmus, the presence of the chlorine is declared by the destruction of the colour.

221. When a current is sent through a solution of iodide of potassium, the brown substance, iodine, is set free where the current enters, while the metal, potassium, is set free where the current quits the solution. The experiment may be made by moistening bibulous paper with the dissolved iodide.

222. In electrolysis, it is usual to immerse two plates of platinum, or of some other suitable substance, in the liquid to be decomposed, and to send the current from plate to plate. The plate at which the current enters the liquid is called the positive electrode; the plate at which the current quits the liquid is called the negative electrode. Without the liquid, these electrodes would, as we have already learned, charge themselves with positive and negative electricity.

223. But, inasmuch as electricities which attract each other are of opposite qualities, the substance which is liberated at the positive electrode is called the electro-negative constituent, while the substance liberated at the negative electrode is called the electro-positive constituent of the liquid.

224. Thus, in the examples above given the oxygen, chlorine, and iodine are the electro-negative elements; the hydrogen, sodium, and potassium being the electro-positive elements.

225. The terms electro-positive and electro-negative are, however, relative, for a substance may be electro-positive in one combination, and electro-negative in another.

226. If an electric current be conducted through a solution of sulphate of soda, it separates the sulphuric acid from the soda; the presence of the acid may be proved by its turning a vegetable colour red.

227. When nitrate of silver or acetate of lead is decomposed by a voltaic current, crystals of silver, or of lead, are deposited on the negative electrode.

228. The chemical actions of the electric current, some examples of which are here given, constitute what is called electro-chemistry.

229. Electro-plating and gilding, and the electrotype process, are important applications of electro-chemistry. Here, a chemical compound, containing gold, silver, or copper, is decomposed by a voltaic current, the metal being deposited on the surface intended to be coated with it.

230. If the surface on which the metal is deposited have a design engraved upon it, the lines of the engraving are accurately filled by the metal, which, when the deposit is thick enough, may be detached, a perfect copy of the design being thus obtained.

Measures of the Electric Current.

231. The *tangent-compass*, devised by Weber, consists of a vertical ring of brass or copper, in the centre of which swings a small compass-needle. The ring being placed in the magnetic meridian, the needle is deflected when a current is sent round the ring. The strength of the current can be proved to be proportional to the tangent of the angle of deflection; hence the name of the instrument.

232. The *voltameter* is an instrument devised by Faraday to measure the strength of an electric current. It consists of a graduated tube, which receives and measures the quantity of gas generated by the current in a given time.

233. The strengths of a series of currents measured by the voltameter are accurately proportional to the same strengths measured by the tangent-compass. Placing a tangent-compass and a voltameter in the same series of circuits, the tangents of the angles observed in the one case are accurately proportional to the quantities of gas generated in the other.

(To be continued.)

NOTICES OF BOOKS.

Paris Universal Exposition, 1867. *Reports of the United States Commissioners. The Progress and Condition of Several Departments of Industrial Chemistry.* By J. LAWRENCE SMITH, United States Commissioner. Washington: Government Printing Office. 1869.

WE owe to the politeness of the United States Government the receipt of this useful report from the hand of a gentleman of high scientific attainments, who has evidently been thoroughly master of the subjects he undertook to report upon. These subjects are:—the manufacture of sulphuric acids; soda and salts of soda; potash and its compounds; ammonia, baryta, magnesia, and alumina; chlorine, fluorine, manganese, and carbonic acid; industrial production of oxygen, hydrogen, and other elements; manufacture of illuminating gas from coal, and the utilisation of the waste products; stearic acid industry; description of the plates.

This is the bare enumeration of the headings of eight chapters, which are preceded by an introduction, from which we give a quotation. After having briefly referred to the importance of class 44 of the exhibition above alluded to, that class embracing chemical products and chemical processes, the eminent author says:—"Industrial chemistry links itself with every modern art in such an intimate manner, that were we to take away the influence and results of chemistry, it would be almost like taking away the laws of gravitation from the universe; industrial chaos would result in one case, as material chaos would in the latter. No one can paint in too vivid colours the sum of indebtedness the civilised world is already under to the chemist, and no enthusiast can transcend in his wildest speculations what we are yet to realise. The chemical arts in their strictest sense do not simply aid other arts, but they keep in activity a vast amount of capital, and consequently give employment to a large number of individuals, skilled and unskilled." As regards the scope of this book, the author informs us that it is not the province of this work to detail the general character of the articles exposed by different exhibitors, except so far as this or that article may possess some special merit. The author of this work has very successfully brought out an excellent book, from which it is our intention to reproduce some articles in full. The chapters on the manufacture of sulphuric acid, soda, and salts are very complete and concisely written treatises on these subjects.

The Royal Polytechnic.—Professor Pepper has lately introduced an amusing entertainment, in which he exhibits the effects, and describes the various modes, of causing ghostly representations of human beings to perform their mysterious movements. His highly interesting lecture, entitled "Sand and the Suez Canal," and a musical entertainment by George Buckland, Esq., are still numbered amongst the attractions.

CORRESPONDENCE.

"ROCHAGE" OF CAST-IRON.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxi., p. 298, you give a brief notice of a paper on this subject by M. H. Caron. This curious phenomenon is well known to those engaged at blast furnaces. The sparks are known by the workmen as "jumpers," and their presence is usually held to indicate an approximation to white-iron. These sparks are absent during the running of grey-iron from the furnace, and only begin to make their appearance when the iron is about No. 4, the usual degree of greyness preferred in South Staffordshire for puddling. The sparks are best observed during the running of white-iron from the furnace, especially if the molten metal is not very fluid, at which times I have frequently observed a vast number produced, particularly in the channel; and sometimes, after the pigs have "set," little jets of sparks are continuously discharged for many minutes, which discharge is accompanied by a hissing sound.

M. Caron's view may probably be correct, but I am inclined to attribute the production of these sparks to the combustion of carbon, and not of iron, as there is an entire absence of the peculiar scintillations displayed by burning iron. Yet one would almost be inclined to believe that grey-iron, which is supposed to contain uncombined carbon, would be more likely to exhibit this appearance than would white- or mottled-iron. Yet, in grey-iron, and even in over-grey, or "Kishy" iron, there is an entire absence of these sparks.

I should be glad to be enlightened by some of your readers upon this curious point—one of the many phenomena of curiosity and interest that are so plentiful at blast-furnaces.—I am, &c.,

T. B.

Stourbridge, July 29, 1870.

MISCELLANEOUS.

Quekett Microscopical Club.—The Fifth Annual General Meeting of this Club was held on Friday evening last, July 22nd, at University College, Gower Street; Peter LeNeve Foster, Esq., President, in the chair. According to the Annual Report of the Committee, which was read, the Club still maintains its popularity and success. It numbers over 500 members, and meets for the prosecution of microscopical enquiry and discussion twice a month throughout the year. Mr. Peter LeNeve Foster in vacating the presidential chair, which he had so ably filled during the past year, delivered his valedictory address, in which he called attention to various open questions in microscopical science, and which were fields well worth the labour required for their investigation, and which, he considered, the members might undertake the study of with pleasure to themselves, and advantage to the world at large. Professor Lionel S. Beale, F.R.S., was elected President for the ensuing year, and Messrs. Henry Lee, F.L.S., Arthur E. Durham, F.R.C.S., Peter LeNeve Foster, M.A., and Dr. Robert Braithwaite were elected Vice-Presidents; while Messrs. Allbon, T. W. Burr, W. M. Bywater, and Charles F. White were elected to fill four vacancies on the Committee. The proceedings then terminated in a *conversazione*.

Diamonds.—At a recent meeting of the New York Lyceum of Natural History, Professor T. Egleston, jun., exhibited a fine suite of crystallised diamonds, including about all of the known forms in which this gem is found. They varied in colour, as well as form, and many were curiously distorted, as well as twins. The distortions of this mineral are very numerous, and of great interest to the mineralogist, as well as dealer in gems. The cube is always opaque. Even if the crystalline form were not well marked, yet a diamond could be told from its peculiar cleavage, which was unmistakable. This cleavage was taken advantage of often in preparing gems for cutting; but sometimes it could not be employed, on account of the shape of the stone, which would be injured in such cases.

An Improvement in Galvanic Batteries.—Mr. W. Poole Levison, of Cambridge, Mass., in a letter to the *Journal of the Franklin Institute*, says:—"In the spring of 1869, while making use of a small bichromate of potash battery, I discovered that the addition of nitric acid to the mixture of potassic bichromate and sulphuric acid, contained in its porous cups, conferred upon it the virtue of *steadiness*, without involving the evolution of annoying fumes. For over two months, during last summer, I had in almost constant action a combination of twenty-three large Bunsen cells charged with dilute sulphuric acid and the triple mixture mentioned, and "set up" openly upon the floor of my room. Not only did I work about it with perfect comfort, but left choice brass instruments in its immediate neighbourhood with impunity. Its energy never fluctuated, but after remaining for some time steady, declined, precisely as if the electro-negative plates were bathed in nitric acid only. To a cooled mixture of potassic bichromate solution and sulphuric acid (perhaps preferably in atomic proportions) add *nitric* acid. The proportion of nitric acid may be greatly varied, as its office is merely to transfer oxygen."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, July 25, 1870.

This number contains the following papers relating to chemico-physical and collateral sciences:—

Observations on some Peculiarities of the Soil of the Landes.—M. Faye.—The author describes, in a lengthy paper, a peculiar sub-soil, locally known (in the Départements des Landes, and a portion of that of La Gironde) as *allios*. This is a layer of a peculiarly-agglomerated sand, intermingled with small pebbles, and containing organic matter, as well as oxide of iron. It (the allios) is met with at a depth of about 1 metre below the surface; and above, as well as below it (its thickness hardly ever exceeding from 1 to 2 metres, and generally less), is found the loose sand which, in former years, was constantly blown about by the winds, but is now retained in its place by the plantations of the pinadas (*Pinus maritima*). The author ascribes the origin of these *allios* to the fact that, during winter and early spring, these extensive plains (the departments above named are the largest in surface of all the French departments) are inundated by rain-water, which, being slowly absorbed by the soil, forms (at the depth already mentioned), in consequence of the matters it contains in solution, and by evaporation, a cement which causes the agglomeration of the underlying sandy sub-soil. In many parts of the barren moors of the Netherlands and Hanover a similar sub-soil occurs, being locally known as *oerbanken*; they often contain the marsh-iron ore in workable quantity.

Analysis of a Schistose Rock Impregnated with a Carbonaceous Matter.—H. Sainte-Claire Deville.—The sample here alluded to is a portion of one which was presented to the Academy by MM. Ravizza and Colomba. The author found that, on being ignited in a closed crucible, this substance loses, as volatile matter, 9·14 per cent. On being further ignited with exposure to air, the quantity of carbonaceous matter burnt off amounts to 0·22 per cent; leaving 90·64 per cent of ash, consisting, in 100 parts, of—Silica, 56; alumina and oxide of iron, 26; lime and alkalies, 18. The mineral, therefore, is simply a schistose rock, impregnated with bituminous matter.

Recent Observations on the Spectra of Various Types of Stars.—A letter from the Rev. Father Secchi, S.J., illustrated with diagrams.

Restoration of a Conically-Shaped Sun-Dial, made so as to Enclose a Fragment of such an Instrument brought from Phenicia.—A. Laussedat.—In the year 1860, a portion of the French army was sent to Syria, and, while there, M. Renan obtained, from the commander of this expedition, a number of men to assist him in making some explorations in and near a locality now known as Oum-el-Awamid (the ancient Phenician name of this locality, a few miles to the south of Tyre (Gour), is unknown). While engaged in digging about, a stone was found bearing inscriptions, and, moreover, seen to be a portion of a peculiarly-constructed sun-dial. The author of this paper describes, at great length, this instrument, which, in its restored form, is illustrated by a woodcut.

New Observations on the Variations of the Magnetic Needle.—M. Broun.—A series of tabulated results on the declination of the needle.

Mechanical Equivalent of Heat; and on the Electro-Thermic Properties of Aluminium.—J. Ville.

Researches on the Bromated Derivatives of Anhydrous Acetic Acid.—H. Gal.—The author has poured over fused acetate of soda, monobromated bromide of acetyl, ($C_4H_3BrO_2$,Br). The mixture, having been distilled, yielded a liquid which, after having been rectified, boiled at 245°, and was, on analysis, found to contain, in 100 parts—Carbon, 18·4; hydrogen, 1·5; bromine, 61·5. Formula, ($C_8H_4Br_2O_3$); that is to say, bibromated anhydrous acetic acid.

Volumetric Estimation of Soluble Fluorides.—P. Guyot.—Since, according to Dr. Nicklès, the fluoride of potassium yields, with perchloride of iron, a white precipitate, Fe_2Fl_6,2KFl, the author has based upon this observation a process of volumetrical estimation of the soluble fluorides. He employs standard solutions of known strength, which are not, however, specifically described as regards their preparation.

Fatty Matters contained in the Chyle of Herbivorous Animals.—Dr. Dobroslavine.—Among the fatty substances discovered by the author, is a mixture of stearic and palmitic acids, oleine, and a fat containing a small quantity of nitrogen.

Note on the Calcareous Rock containing the Terebratula Diphya in the French Alps from Grenoble to the Mediterranean.—Dr. Dieulafait.

Chemical Examination of a Piece of Cement Metamorphised while Immersed in the Water of Bayen de Luchon.—F. Garrigou.—In the year 1852, a piece of cement (in all likelihood, an hydraulic cement, since some of it was used to line the cavities of the rock through which the water of the above-named spring runs), of the size of two fists, was placed in a reservoir constantly filled with the warm (64°) water of the spring alluded to. The original cement contained a large proportion of carbonate of lime. The metamorphised material was found to have taken up a large quantity of silica, some fluorine, and organic matter.

Contemporaneousness of Man, with the Large Ursus Spelæus, and the Reindeer in the Caverns of Gargas (Haute Pyrénées).—F. Garrigou and De Chasteigner.

Application of Thin Sheet-Lead, instead of Lint, in Wounds. Dr. Burggræve.—The author states that lead feels soft and cool to the wounded parts; its use entirely supersedes that of lint. The formation of a very thin layer of sulphuret impedes putrefaction and the development of small organisms. When once the wound has been dressed with lead, it may be washed as often as desired with water, without the necessity of removal of the dressing. Lastly, the use of lead renders summary operations frequently unnecessary.

Preparation of Aluminium-Ethyl.—Dr. Cossa, in a very short letter to M. H. Sainte-Claire Deville, says that, according to his researches, aluminium acts, at the ordinary temperature, upon iodide of ethyl enclosed in sealed tubes. Aluminium-ethyl was also prepared by the author by causing aluminium to act upon stannethyl.

Programme de la Société Hollandaise des Sciences de Haarlem, Année 1870.

On the 21st of May last, the general yearly meeting of this scientific Society was held at Haarlem. The Huyghens medal (see Chemical News, vol. xx., p. 57) has been granted to M. Rudolph Julius Emmanuel Clausius, Professor of the University of Bonn, as principal founder of the dynamic theory of heat. Dr. A. W. H. Kolbe, of Leipzig University, was elected foreign member of this Society. Among the questions open for competition, and to be answered on or before the 1st of January, 1872, we notice the following:—The mode of origin and the part *wax* plays in living plants; to be investigated by anatomical and micro-chemical researches. To elucidate, by original research, the history of the development of certain malformations and excrescences produced upon oak-trees by various gallicolous *Hymenopterous* insects; it is desired that, in this investigation, the influence of the insect in its successive phases of development, as well as the morphological, anatomical, and chemical changes the part of the plant affected undergoes, shall be duly taken into consideration. Critico-historical exposition of the discovery and development of spectrum analysis, and its applications to chemistry and astronomy. The mathematical theory of the induction coil (*bobine*). Since the value of the constant aberration, as deduced by Delanbre from the eclipses of Jupiter's first satellite, differs from the aberration as resulting from later astronomical measurements, and since the cause of that difference is not yet well ascertained, it is desired that a collection be made of all the observations made on the eclipses of Jupiter's first satellite which are recorded in and disseminated through different periodicals, and also that, from these data, a new determination of the constant value of aberration be made. A new series of researches on the influence which the different colours of the spectrum have upon the so-called respiration of the green parts of plants. New series of investigations and researches to be made of the organic bases contained in the genus *Cinchona*. The Society's gold medal, and, in addition thereto, a premium of £25, will be given to him who finds, either by means of kites or captive balloons, the means of elevating, to great height in the sky, meteorological instruments, so that they may be kept in that position for at least twenty-four hours. The Society's gold medal will be granted for the production of any self-acting and accurately self-registering meteorological instrument—thermometer, barometer, hygrometer—suitable to be fixed to a kite or a captive air balloon for at least twenty-four hours, and so constructed (viz., the instruments) as to give satisfactorily the results of the state of the atmosphere at great height. The two questions open for competition to January, 1873, relate to botany and zoology, The Society desires to recommend to the competitors for prizes to omit, in their answers to questions, any matters not directly relating to the proposed question. It is, moreover, desired, that whatever be sent into the Society should be worked out with accuracy, and that every proposition be well defined and demonstrated, and not mixed with vague theories or badly-digested and not well established facts. The memoirs sent in must on no account whatever be written in the handwriting of the authors themselves, as in this case, even were these memoirs worthy of the award of the medal, no award could be made, according to the Society's rules. The envelopes added to the memoirs sent in, and appended thereto by a peculiar mark, and containing the author's name, will, in case no award is granted, be burnt unopened. The memoirs to be sent in for competition may be written in Dutch, French, Latin, English, Italian, or German languages, at the author's option, provided, in the case of the German language, the italic, and not the peculiar German mode of writing, be used. All such documents, and the envelopes appended thereto, and just alluded to, should be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, the Secretary of the Society, residing at Haarlem, North Holland, Netherlands. The prize offered for a satisfactory memoir or answer to each of the proposed questions is the Society's gold medal, value £12 10s., bearing the author's name and the year of issue; or, if the author desires it, the full money-value of the medal. In some cases, it is left to the umpires of the awards to grant an additional award of the value just mentioned. The competitor to whose memoir a prize shall have been awarded may not, without the express consent and authorisation of the Society, print or publish, either in whole or part, separately or in any periodical, the memoir to which the prize has been awarded.

Zeitschrift für Chemie von Beilstein, No. 11, 1870.

This number contains the following original papers and memoirs:—

The Isomeric Toluolsulpho Acids.—A. Wolkow.—After referring at great length, to the preparation and purification of the compounds, and their separation from each other, the author describes—α, or toluol-parasulpho acid, $C_7H_7(HSO_3)p$, and the potassa-salt of that acid, $C_7H_7(KSO_3)+H_2O$, which is obtainable in large six-sided prismatic crystals; the chloranhydride of the toluol-parasulpho acid, $C_7H_7(SO_3Cl)p$; the amide of toluol-parasulpho acid, $C_7H_7(SO_3NH_2)p$; paratoluide of toluol-parasulpho acid; meta-nitrotoluol-parasulpho acid and its chloranhydride and amide; paratoluide—

$$C_7H_6(NO_2)m(SO_3C_7H_7(NH)p)p;$$

toluol-metasulpho acid; the amide of the toluol-metasulpho acid. All these, and some derivatives thereof, are described at very great length, but so as to render any further useful abstraction impossible.

Conversion of the Primary Normal Butyl-Alcohol into the Secondary Butyl-Alcohol, or Methyl-Ethyl-Carbinol.—Dr. A. Saytzeff.—By heating the iodanhydride of the normal butylic alcohol with an alcoholic solution of caustic potassa, the author obtained butylen, which was combined with HI; the ensuing compound was converted into a corresponding acetic ether, and this into an alcohol which boiled at about 100°. The oxidation of that alcohol yielded methyl-ethyl-keton and acetic acid, while the alcohol was proved to be methyl-ethyl-carbinol. These reactions are represented by—

$$\left.\begin{matrix}CH_3\\CH_2\\CH_2\\CH_2I\end{matrix}\right\}+KHO=\left\{\begin{matrix}CH_3\\CH_2\\CH\\CH_2\end{matrix}\right\}+IK+H_2O,\left\{\begin{matrix}CH_3\\CH_2\\CH\\CH_2\end{matrix}\right\}+IH=\left\{\begin{matrix}CH_3\\CH_2\\CHI\\CH_3\end{matrix}\right\}$$

Formation of Chloride of Carbon, C_2Cl_6, from Acetic Acid.—H. Hubner and F. C. G. Muller.—After referring to the researches of Dr. Samosadsky, the authors describe, at length, a series of experiments and preparations, from which they infer that acetic acid, when acted upon by the chloride of phosphorus, exchanges its oxygen for chlorine; so that, as a final result of this reaction, the chloride of carbon is obtained.

Composition of Sugar-Cane.—O. Popp.—The author has analysed fresh sugar-cane, after pulling the leaves off. Martinique and Guadeloupe cane (America) contains, in 100 parts—Water, 72·22; cane sugar, all crystallisable, 17·80; glucose, 0·28; cellulose, 9·30; salts, 0·40. African canes: Middle Egypt (Cairo) contains, in 100 parts—Water, 72·15; cane sugar, 16·0; glucose, 2·3; cellulose, 9·2; salts, 0·35. Upper Egypt—Water, 72·13; cane sugar, 18·1; glucose, 0·25; cellulose, 9·1; salts, 0·42. The author adds, that the quantity of sugar above

quoted is an average quantity, since its percentage may reach as high as 20, while the glucose may be entirely absent, and is so in some kinds of cane (different species of the plant), and with good cultivation in all kinds. Sugar-cane dried at 100°, previously deprived of its leaves, yielded from 3·8 to 4·3 per cent of ash; the dried leaves yield by themselves from 8·0 to 8·5 per cent of ash. The composition of the ash of the American cane, without leaves, is, in 100 parts—Potassa, 7·66; soda, 6·45; lime, 12·53; magnesia, 6·61; oxide of iron, 0·56; silica, 43·75; phosphoric acid, 5·45; sulphuric acid, 16·53; chlorine, 0·21—together, 99·75. Ash of the leaves, in 100 parts—Potassa, 10·65; soda, 3·26; lime, 8·19; magnesia, 2·45; oxide of iron, 0·85; silica, 65·78; phosphoric acid, 1·25; sulphuric acid, 2·18; chlorine, 1·65; carbonic acid, 3·55—together, 99·81.

Qualitative Detection of Sulphurous Acid and Volumetric Estimation of Iron.—O. Popp.—When an acid solution of perchloride of iron is added to a solution of hyposulphite of soda, there is obtained a very deep brownish red colouration, soon passing to amethyst red, and then disappearing, leaving a colourless fluid. The disappearance of the colouration is instantaneous at from 40° to 45°. The author advocates the application of this colouration as a qualitative test for hyposulphites, as well when by themselves as when mixed with sulphates or sulphites. The latter also reduce iron, but without the appearance of the colouration alluded to, which is due to the conversion of the hyposulphurous acid into tetrathionic acid by the action of the acid perchloride of iron. This reaction, which is analogous to the action of iodine upon hyposulphite of soda, takes place according to the formula—

$$2Na_2S_2O_3 + Fe_2Cl_6 = Na_2S_4O_6 + 2NaCl + 2FeCl_2,$$

or, rather, because a free acid has to be present; and free tetrathionic acid is formed according to the formula—

$$2Na_2S_2O_3 + Fe_2Cl_6 + 2HCl = H_2S_4O_6 + 2FeCl_2 + 4NaCl.$$

The author mentions briefly the volumetric estimation of iron as proposed to be carried on by Dr. A. C. Oudemans, which process is based upon the reaction alluded to; but since we intend to give the paper thereupon in full, we abstain now from quoting the brief description of that process as given here.

Researches on Mesitylen-Sulpho Acids of Mesitylen.—H. Rose.—After referring briefly to Dr. Jacobsen's investigations on this subject, the author treats on the action of bromine upon mesitylen-sulpho-acid, stating that that haloid acts upon the acid, even when care is taken to cool the mixture, most energetically; but, by a circuitous process, the brom-mesitylen-sulpho acid was obtained. In free state, that acid, a solid body, is very soluble in water, alcohol, and ether, from which latter fluid it is most readily obtained in crystals. This substance is very deliquescent, but its salts are difficultly soluble in water. The author describes the baryta, lead, potassa, soda, and copper salt, the formula of the latter being—

$$[C_6(CH_3)_3HBrSO_3]_2Cu + 4H_2O.$$

The author then treats on the preparation of brom-mesitylen-sulpho acid from monobrom-mesitylen, the body thus obtained, and its salts, being found to be identical with those previously alluded to; researches and experiments on the action of fuming nitric acid upon mesitylen-sulpho acid, and the action of fuming sulphuric acid on the products resulting from the action of nitric acid, are in course of execution.

Glycerine Compounds, and a New Kind of Formation of Allylic Alcohol.—H. Hubner and C. Muller.—The contents of this paper relate chiefly to some rectifications needed in the results of the experiments of Professor Berthelot on this subject, for the authors, while repeating his (Berthelot's) experiments, found very great discrepancies in the results, although exactly carrying out the instructions given by the *savant* alluded to.

Moniteur Scientifique, No. 325, July 1, 1870.

This number does not contain any original memoirs or papers related to chemistry, but we meet here, under the title—

Acoustical Attraction and Repulsion—J. Guyot—A reproduction of a paper from a defunct French scientific periodical, here reproduced to show that the experiments Dr. H. Schellbach, in Germany, and Dr. Guthrie, in London, are busy with on this subject were already, to a great extent, made in 1832 by the author.

American Journal of Pharmacy, July, 1870.

This number contains the following original papers and memoirs relating to chemistry, besides several excellent strictly pharmaceutical papers:—

Vaccinine, a Crystalline Principle Extracted from the Leaves of the Cowberry (*Vaccinium vitisidæa*, *L.*).—E. Claussen.—The amount of vaccinine in the shrub is about 1 per cent; it forms long acicular crystals, of somewhat bitter taste and devoid of smell. This substance is scarcely soluble in ether, better so in cold water and alcohol, but best of all in boiling water; a saturated solution of this substance in the latter yields, on cooling, a solid mass. When the crystalline substance is heated, it melts to a clear liquid. It is not precipitated by either sub-acetate of lead or tannin, is neutral to test-paper, and contains no nitrogen.

Simple Apparatus for Rapid Evaporisation at Limited Heat, under Reduced Pressure, without the Use of a Pump.—A. B. Prescott.—The author describes, at some length, the use of ordinary distilling apparatus for the production and maintenance of an approximate vacuum over liquids during their evaporation, in cases where the heat of 120° to 150° F. may be applied.

Report of Professor C. F. Chandler to the Metropolitan (New York) Board of Health, on Various Hair Tonics, Washes, Cosmetics, and other Toilet Ingredients.—The author, by direction of the Board of Health, has investigated the composition of the following articles, viz.:—Hair tonics, washes, and restoratives; lotions for the skin; enamels; white powders for the skin. Of the substances named in the first category, sixteen were examined, all of which, with but one exception, were found to contain lead, generally in the form of the acetate or sugar of lead. No. 11 among these samples is Mrs. S. A. Allen's "world's hair restorer," of 198 and 200, Greenwich Street, New York. One fluid ounce of this cosmetic (largely advertised) contains—Lead in solution, 5·25 grains; lead in the sediment, 0·31 grains—total, 5·57 grains. The one sample free from lead was an ammoniacal solution of nitrate of silver, containing 4·78 grains of the nitrate in 1 fluid ounce. Of the lotions for the skin (six different samples were analysed), only one was made up with injurious metals—viz., an American compound, known as "Perry's moth and freckle lotion," containing, to the fluid ounce—Corrosive sublimate, 3·61 grains; and crystallised sulphate of zinc, 4·25 grains. Among the enamels for the skin, seven different samples were tested, among which, three containing from 108·94 to 190·99 grains of white-lead in 1 fluid ounce; other samples were found to contain oxide of zinc. The white powders for the skin were found to be chiefly made up of carbonate of lime and magnesia, clay, and French chalk; and as far, therefore, as these materials are concerned, are harmless, except in so far as their application may interfere with the healthy action of the skin.

Ambrosine.—C. U. Sheppard.—With this name is indicated a new fossil resin found in the phosphate bed of South Carolina. The colour of this material is brown; fracture, conchoidal; lustre, resinous; sp. gr., slightly greater than that of water; feebly translucent; becomes strongly electric by friction; melts, at about 460° F., into a clear yellowish liquid; gives off some succinic acid on being heated; is very combustible; is soluble in oil of turpentine, alcohol, ether, and chloroform, also in solution of caustic potassa; and is not decomposed by strong mineral acids.

Archives Néerlandaises des Sciences Exactes et Naturelles, vol. v., parts 1—3, inclusive.

These numbers contain the following original papers and memoirs:—

Temperature of Volatilisation; and on the Specific Heat of Solid and Liquid Bodies.—J. A. Groshans.—This very lengthy essay is an algebraico-physical treatise on this subject.

Simple Method for the Exact and Precise Comparison of Measures of Length.—F. J. Stamkart.—This excellent paper, illustrated with several engravings, was originally written and published in Dutch, as far back as the year 1839, but is here reproduced in French at the suggestion of Professor F. Kaiser, partly in order to prove to M. Steinheil, of Munich, that the author (M. Stamkart) had, some thirty years ago, already invented what the German *savant* has lately described under the name of *fuhlspiegel*, and chiefly because M. Stamkart's invention is of the highest importance just now for the purpose of aiding the exact reproduction of the standards of length (*étalon prototype*) of the metre.

Determination of Small Differences of Length, the Measurement of Minute Thicknesses in Small Objects, and the Observation of Very Small Displacements in Large Objects.—F. J. Stamkart.—Illustrated with several engravings.

Morphology of the Shoulder-Muscles of Birds.—Emil Selenka.

Movements of the Eye Illustrated by means of the Phenophthalmotrope.—F. C. Donders.

New Materials to serve for the Knowledge about Cycadææ.—F. A. W. Miquel.

Contributions to our Knowledge of the Flora of Japan.—F. A Miquel.

Specific Gravity of Alcohol, and of Mixtures of Alcohol and Water.—Dr. E. H. von Baumhauer.—This paper, is written chiefly in order to review the labours of M. D. Mendelejeff* on this subject, and compare the results obtained by him with those the author obtained while exhaustively investigating this subject some ten years ago. The author fully and satisfactorily proves that the strong criticism of M. Mendelejeff against his (Dr. von Baumhauer's) labours on this subject is quite erroneous; and he also, by a new series of very accurately-performed experiments, fully confirms the results before obtained by him. The sp. gr. of absolute and perfectly pure alcohol is, at 15°, equal to 0·7940, water at its greatest density being taken as unit.

New Species of Argostemma: a Contribution to the Flora o the Netherlands' East Indies.—W. F. R. Suringar.

Two New Species of Crustaceæ Living as Parasites on Fishes (Epichthys and Ichthyoxenos).—J. A. Herklots.—With a series of engravings.

Observations on the Character and Formation of Suber and Liber in Dicotyledonous Plants.—N. W. P. Rauwenhoff.

On the Crystallites.—H. Vogelsang.—A crystallo-genetic essay illustrated with engravings.

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* *Poggendorff's Annalen*, vol. cxxxviii., pp. 103—141 and 230—279.

Specific Heat of Solid and Liquid Bodies.—J. A. Groshans.—Second essay on this subject.

Place to be Assigned to the Chiromys in the Natural Classification of Animals.—C. K. Hoffmann and H. Weyenbergh, jun.

Results obtained by the Mathematical Study of the Movements of the Eye.—G. F. W. Baehr.

The Petrified Forest of Cairo, the Cliffs of Black Earth and Broken-up Crockery Ware of Lower Egypt, and the First Cataract of the Nile.—H. Hartogh Heys van Zouteveen.

Synthesis of Sulphocyanate of Ammonium.—H. Hartogh Heys van Zouteveen.—When a current of dry ammonia gas is passed through sulphide of carbon at the ordinary temperature of the air, no reaction whatever is stated to take place, according to M. Berthelot, but the author of this paper says—When dry ammonia gas is made to pass through sulphide of carbon, that liquid becomes first yellow, and, after depositing a brick-red coloured substance, becomes colourless again. This deposit, having been separated and dissolved in water, yielded, on partial evaporation of that liquid, some sulphide of carbon and sulphide of ammonium, which volatilised, while a small quantity of sulphur was deposited. The remainder of the solution was found to contain sulphocyanate of ammonium, readily recognised by its behaviour with chloride of iron. The reaction which took place is the following:—

$$CS_2+2NH_3=CSNH_3(NH_4)S.$$

Likewise—

$$COS+2NH_3=CSNH_3(NH_4)O,$$

that is to say, first, sulphocarbaminate of ammonium was formed, and this was split up, by the heat applied to its aqueous solution, into sulphide of carbon, sulphide of ammonium, and sulphocyanate of ammonium—

$$2CSNH_3(NH_4)S=CS_2+(NH_4)_2S+\left\{\begin{matrix}CN\\NH_4\end{matrix}\right\}S.$$

Observations on Holtz's Electrical Machine.—V. S. M. van der Willigen.

Volumetric Estimation of Iron by means of Hyposulphite of Soda.—A. C. Oudemans, jun.—This lengthy essay is chiefly written with the view to prove that the critical remarks on the author's former papers on this subject, made by Dr. Mohr, are entirely imaginary. The author has slightly modified his method of operating; but it appears, after all, that, for all practical purposes, his method, as at first described, was found to answer well, as indicated, also, by no less an authority than Dr. Fresenius, not to mention others beside. This paper contains, moreover, the tabulated results of a new series of experiments, which leave nothing to be desired for accuracy.

Observations on Parthenogenesis with Lepidoptera.—H Weyenbergh, jun.

Origin and Development of the Periphyllus Testudo.—H. C. Ritsema.

Abstract of a Report on the Purification of the Air of Hospitals by means of the Combustion of Organic Germs.—J. van Geuns and E. H. von Baumhauer.—An abstract of a report on M. Woestyn's proposal to purify the vitiated air of hospitals, previous to its exit into the atmosphere, by means of a high temperature (or even red heat), from any organic and organised germs it might happen to contain. The authors point out that M. Woestyn's method, as proposed, is not complete, and not such as to fully carry out the object desired.

Revue Hebdomadaire de Chimie, July 7, 1870.

Manufacture of Carbonate of Baryta and of Artificially-Made Barytic Stones.—M. Allain.—The author employs the native sulphate of baryta of commerce, converts it as usual, first, into sulphuret of barium, and this (by the aid of chloride of zinc) into chloride of barium, and this again (by means of carbonate of soda) into carbonate of baryta. The artificially-made stones consist of a mixture of 2 equivalents of silica, 3 of silicate of alumina, and 10 of carbonate of lime. This mixture having been first ignited, is ground to powder, and there is then added 3 equivalents of powdered carbonate of baryta. This dry mixture is passed through a sieve, and kept in closed vessels free from contact of air. When wanted for use, the mass is mixed with water, and next moulded into the desired shape, yielding, on drying, a very hard, stony material.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 209, May, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Report on a Water-Meter Constructed by M. Chameroy fils.—M. Tresca.—The author of this paper, which is illustrated with engravings, speaks in very high terms of the accuracy and efficacy of this piece of machinery, the action of which is based upon an entirely new principle, the maker having succeeded in rendering the flow of the water dependent upon a difference in pressure between the main- and service-pipes, while this value has been rendered effectively invariable. This paper is a valuable contribution to our knowledge about water-meters generally.

Report upon an Annular Kiln, Continuously Working, for Bricks and Pottery.—V. Bois.—This paper, also, is illustrated with engravings, and treats of the construction of a peculiar kind of brick and pottery kiln, the invention of a M. Hoffmann, at Berlin. It appears that this contrivance is suitable, not only for firing bricks, but also for the burning of lime, cement, pottery-ware, and plaster of Paris.

Report on M. Jordan's Work on the Iron Industry.—M. Lamy.—It appears that M. Jordan's published work is one of the most complete hitherto issued on this subject.

Report on the New System of Conveying Beet-Root Juice, according to M. Linard's Proposal.—M. A. Payen.—The author treats of a contrivance whereby the beet-root juice is pressed from the roots, and carried, by cast-iron pipes, to the beet-root sugar-works. The roots are pulped, and the juice expressed, so to say, on the very spot where the roots are grown; and the juice is conveyed, by pipes laid underground (as are gas- and water-pipes) and along the roads, to the beet-root sugar-works, while a portion of these pipes are used in summer time to carry and force up fresh water to the farms.

Cosmos, July 23, 1870.

Coal Formation of the Lofoden Islands (Norway).—S. Meunier.—It appears that, in the Island of Ando, one of the Lofoden group, a seam of coal has been discovered, which, in physical and other properties, bears a resemblance to the well-known boghead, but the thickness of the layer is irregular, and does not, as far as has been ascertained, exceed 20 inches. The diameter of this coal basin is about 2300 metres.

Meteorite of Lodran.—Dr. Tschermak.—This stone contains, in 100 parts—Nickeliferous iron, 32·5; olivine, 28·9; bronzite, 31·2; magnetical pyrites, 7·4. The author gives, at length, the separate analysis of each of the enumerated mineralogical constituents.

Unlimited Filtration of River Water.—Dr. Burg.—A lengthy description of an arrangement for filtering the water of rivers, but only, it appears, intended to be applied where no navigation is carried on.

Prevention of Boiler Incrustations.—V. Bois.—The author employs the agglutinated offal of hoofs and horn for this purpose, and states that very satisfactory results have been obtained by the application of this substance, and that even old incrustations are rendered friable, so as to be readily removed.

Revue des Cours Scientifiques de la France et de l'Etranger, July 30, 1870.

This number does not contain any original papers or memoirs directly relating to chemistry or collateral sciences, but it contains—

The Backwardness of Science among the Ancients.—C. von Littrow—Being his inaugural speech at the University of Vienna. This paper contains several noteworthy facts, among which we mention the following:—The use of the compass in navigation was known to the Chinese in the fourth century; the Arabs made the Europeans acquainted with India in the eighth century, and the crusades of the tenth century brought numbers of Europeans to the eastward, yet the use of the compass was not introduced into Europe until the twelfth century.

Death of M. Daniell Dollfus Ausset.—The town of Mulhouse has just lost a very celebrated citizen, the gentleman just named, brother of the celebrated manufacturer, M. J. Dollfus. The deceased had left the pursuits of industry to devote his time entirely to science, and especially to geology and mineralogy. He was one of the most expert explorers of the alpine glaciers, and his extensive researches in science associate his name with those of Agassiz, Des Desor, and Des Martius. The deceased was a man of great wealth, and was highly respected by all who were acquainted with him.

NOTES AND QUERIES.

Waterproofing.—I shall esteem it a favour if you can inform me of the most approved composition for rendering cloth waterproof; I mean such as is used for tarpaulins of a light colour.—M. A. S.

Carbolic Acid.—"Fitzetienne" would be glad to know of any tolerably accurate method of determining the percentage of carbolic acid in dead oils and other liquids containing small quantities of the acid.

TO CORRESPONDENTS.

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ON THE

COMBINATIONS OF CARBONIC ANHYDRIDE WITH AMMONIA AND WATER.*

By EDWARD DIVERS, M.D., F.C.S.

THE following paper contains an account of some investigations upon the chemical reactions and combinations with each other of carbonic anhydride, ammonia, and water.

The Ammonium Carbonates.

There are certainly three combinations of ammonia and carbonic anhydride, into the formation of which water enters in sufficient relative quantity to allow of their being represented as ammonium-salts of carbonic acid —the normal, the half-acid, and the acid carbonates.

1. *The Normal Carbonate.*—This salt can be prepared by acting on the commercial "carbonate of ammonia" with solution of ammonia. Being only sparingly soluble in the presence of much free ammonia, the normal carbonate is easily obtained in the solid state by using the ammonia in sufficient excess. When the solid commercial salt is treated with strong solution of ammonia, the normal carbonate is left as an indistinctly crystalline, mealy solid; when a concentrated aqueous solution of the commercial carbonate is treated with ammonia gas, the normal salt is thrown down as a crystalline precipitate; when a warm saturated solution of the commercial carbonate in dilute solution of ammonia is set aside, the normal salt is obtained in large crystals; lastly, when a weaker ammoniacal solution of the commercial salt is mixed with alcohol, the normal carbonate is deposited. It can also be formed by allowing a warm concentrated solution of ammonium carbamate in water, or, preferably, in solution of ammonia, to crystallise. But the most interesting way in which it can be prepared is that of treating the same quantity of water a great number of times with fresh quantities of the commercial carbonate at a gentle heat, and allowing the solution to cool and deposit crystals after each addition, when the mother-liquor from the last crop of crystals which forms on cooling will yield large crystals of the normal carbonate on being set aside for some days.

Dalton has given two methods by which he obtained the normal carbonate—one of which was by distilling the commercial carbonate, and collecting the first product of the distillation before it had been exposed to the air; and the other, by adding to a warm saturated solution of the commercial carbonate sufficient ammonia-water to raise the proportion to the proper degree, when, on cooling, it was copiously precipitated. The latter of these methods only succeeds, however, when the ammonia is added in good excess; concerning the former of them, it is to be observed that, when the commercial carbonate is first heated, long fibrous crystals form, but only in small quantity, on the walls of the retort-neck, before the real distillation commences. (Crystals, apparently the same, form on the sides of bottles soon after freshly-made commercial carbonate is stored in them.) These must be the salt which Dalton found (and probably correctly) to be the normal carbonate, as the first product of the real distillation of the commercial salt is, according to the analyses of both H. Rose and the author, not a true carbonate at all.

Ammonium carbonate occurs in the form of elongated plates or flattened prisms. It is intensely ammoniacal in smell and taste. Its composition is expressed by the formula $CO_2(OH_2)_2(NH_3)_2$. Dalton represented it as containing only half this proportion of water, but a comparison of his percentage numbers for it with those he gave for the acid carbonate shows that the salt in his hands really had the composition expressed by the above formula.

Exposed to the air, the crystals are very rapidly destroyed—ammonia escaping, and a wet mass of acid carbonate remaining behind. This change may be expressed as follows:—

$$CO_2(OH_2)_2(NH_3)_2 = CO_2OH_2NH_3 + OH_2 + NH_3.$$

At about 58° C., it is converted into water, carbonic anhydride, and ammonia. It is soluble in its own weight of water, or slightly more, at 15°. When boiled, the solution gradually loses the salt, but does not otherwise change in composition. A warm saturated solution exhibits the phenomenon of supersaturation and sudden crystallisation in a well-marked manner, when it is allowed to cool in a closed vessel. The normal carbonate is insoluble in, and is decomposed by, alcohol; it is only very sparingly soluble at low temperatures in solution of ammonia. At a heat of 20°—25°, it is dissolved, with decomposition, in considerable quantity, in strong solution of ammonia, ammonium carbamate being formed. As a means of obtaining crystals of the carbamate, this interesting process for dehydrating the carbonate in solution will be again referred to.

2. *The Half-Acid Ammonium Carbonate.*—Rose obtained this salt by distilling the commercial carbonate very slowly until the contents of the retort liquefied, and leaving the liquid thus obtained to crystallise. H. Sainte-Claire Deville prepared it by crystallising a solution of the commercial carbonate in ammonia-water. It can also be obtained by the action of water on the commercial carbonate —by proceeding as in preparing the normal carbonate— the crops of crystals at length obtained on cooling the warm solutions consisting of the half-acid carbonate. Another method of getting it is to distil the ammonio-magnesian carbonate, the products being a fluid distillate depositing crystals of the half-acid carbonate, and a solid directly condensed, consisting principally, also, of this carbonate. It can also be formed by the action of alcohol on a solution of normal carbonate. It cannot be obtained, although the contrary has been asserted, by cooling a solution of the commercial carbonate to about 0°.

The half-acid carbonate occurs in the form of either thin, elongated, six-sided plates, or flattened right rectangular prisms, terminated by the faces of a rhombic octahedron. The properties of this carbonate appear to be all intermediate to those of the normal and the acid carbonates. The half-acid carbonate has a composition expressed by the formula $(CO_2)_3(OH_2)_4(NH_3)_4$. Rose found it to have another atom of water; but, as he has represented in the same paper some other salts as containing more water than they have been found by other chemists to contain, his results in this case may fairly be questioned. Deville deduced the same composition for this salt from his analyses as that given by Rose, because this was indicated by their mean results. But every sample analysed by him contained adhering water, and one very much more than another; so that it was obviously not right to take the mean results of the analyses as the nearest approach to the true composition of the salt. His analyses indicate, unequivocally, that he examined a half-acid carbonate with much less than five atoms of water—most probably, therefore, with only four atoms of (combined) water, as represented by the above formula.

The half-acid carbonate is soluble in a little more than five times its weight of water at 15°; it is decomposed by less water. The mother-liquor of crystals of the half-acid carbonate is always either neutral, or slightly alkaline, in composition—that is, contains at least two atoms of ammonia to one of carbonic acid.

* Abstract, by the Author, of a paper communicated to the Chemical Society.

3. *The Acid Ammonium Carbonate.*—Unless Rose obtained, as he believed he did, crystals of this salt isomorphous with those of the acid potassium carbonate, it crystallises in only one form, though this may vary very much in the development of its proportions. Rose found the acid carbonate to vary in its degree of hydration, but his results are not in accordance with those obtained by other chemists. At about 60°, it is slowly decomposed into carbonic anhydride, ammonia, and water; on distilling it very slowly, the products of the distillation condense to nearly pure crystalline acid carbonate again. The acid carbonate dissolves in about 8 parts of water at 15°. When some of it is added to a cold saturated solution of itself, it is slowly decomposed, with evolution of bubbles of carbonic anhydride. A warm saturated solution, prepared in a closed vessel under pressure, deposits opaque crystals of it on cooling. A solution of it is converted into a much weaker solution of normal carbonate by boiling it for a time in a flask or retort. The acid carbonate is unaffected by alcohol. Dropped in powder into strong solution of ammonia, it is converted, with the production of a hissing sound and some heat, into a much greater bulk of normal carbonate, which deposits, and a salt which dissolves in the ammonia-water and crystallises out in small quantity on the walls of the vessel, when this is cooled to 0°, soon after the mixture is effected. This salt is probably ammonium carbamate, formed thus—

$$2CO_2OH_2NH_3 + 2NH_3 = = CO_2(OH_2)_2(NH_3)_2 + CO_2(NH_3)_4.$$

By digesting the acid carbonate with the strongest solution of ammonia, in a closed vessel at a temperature of 20°—25°, ammonium carbamate is slowly formed in considerable quantity.

The Hyper-Acid Ammonium Carbonate.—Rose obtained this, crystallised from solution, on more than one occasion. He proposed for it the two complex formulæ—

$$(CO_2)_9(OH_2)_{10}(NH_3)_8 \text{ and } (CO_2)_9(OH_2)_9(NH_3)_8;$$

but, as it soon passes into the acid carbonate spontaneously, and is, besides, formed under circumstances which generally bring about the formation of the acid carbonate, it may, with more probability, be regarded as mixed, when obtained with acid carbonate, and represented as having, when pure, the formula—

$$(CO_2)_5(OH_2)_4(NH_3)_4.$$

Constitution of the Carbonates of Ammonium.—The most characteristic reaction of the acid carbonate can only be represented as occuring in the quantity expressed by the formula—

$$(CO_2)_2(OH_2)_2(NH_3)_2;$$

viz., the reaction by which, when warmed with a little water, it passes into carbonic anhydride and the normal carbonate, thus—

$$(CO_2)_2(OH_2)_2(NH_3)_2 = CO_2 + CO_2(OH_2)_2(NH_3)_2.$$

The acid carbonate being thus represented, the half-acid one may be regarded as a simple combination of it with the normal carbonate, thus—

$$(CO_2)_3(OH_2)_4(NH_3)_4 = = (CO_2)_2(OH_2)_2(NH_3)_2 + CO_2(OH_2)_2(NH_3)_2.$$

The probably tetrabasic character of carbonic acid in many of its salts is recognised by many chemists. The greatest objection to admitting this tetrabasic character seems to be that it shows apparently a dibasic character in a great number of its salts. This difficulty would be removed were the apparently dibasic salts represented as tetrabasic; and facts in the history of many of these carbonates appear to give support to the supposition that in them carbonic acid is actually tetrabasic. This is particularly the case with the carbonates of ammonium. That which is the normal carbonate of dibasic carbonic acid, with an atom of water of crystallisation, becomes a half-saturated salt of the tetrabasic acid; and that which is the acid salt of the dibasic acid becomes an anhydro salt of the tetrabasic acid, in accordance with its chemical behaviour; while, lastly, the half-acid carbonate of the dibasic acid, with its one atom of water of crystallisation, so oddly associated with the treble molecule of carbonate, becomes a double salt of the other two tetra- or ortho-carbonates, thus:—

	Dibasic.	Tetrabasic.
Normal..	$CO_3(NH_4)_2,OH_2$.	$CO_4(NH_4)_2H_2$.
Half-acid	$(CO_3)_3(NH_4)_4H_2,OH_2$.	$CO_2(CO_4)_2(NH_4)_4H_4$.
Acid ..	CO_3NH_4H.	$CO_2CO_4(NH_4)_2H_2$.

Admitting, with Rose, the existence of a hyper-acid carbonate, and adopting for it the formula proposed in this paper, the series of carbonates of ammonium which crystallise from their solutions stands thus:—

$(CO_2)_2(OH_2)_4(NH_3)_4$ or $[CO_4(NH_4)_2H_4]_2$;
$(CO_2)_3(OH_2)_4(NH_3)_4$ or $CO_2[CO_4(NH_4)_2H_2]_2$;
$(CO_2)_4(OH_2)_4(NH_3)_4$ or $(CO_2)_2[CO_4(NH_4)_2H_2]_2$;
$(CO_2)_5(OH_2)_4(NH_3)_4$ or $(CO_2)_3[CO_4(NH_4)_2H_2]_2$.

The regularity of this series is remarkable, and favours the theory that the half-acid, acid, and hyper-acid carbonates are anhydro compounds of the normal carbonate.

The Normal Ortho-Carbonate of Ammonium.—If the normal meta-carbonate is considered to be an acid ortho-carbonate, a normal ortho-carbonate—that is, a salt having the formula $CO_4(NH_4)_4$—may be supposed to exist. Aqueous spirit converts the commercial carbonate, both solid and in solution, into acid carbonate and a solution more alkaline in composition than the normal meta-carbonate. It acts similarly on a solution of normal meta-carbonate. When water is treated repeatedly with quantities of the commercial carbonate until crops of the half-acid carbonate are obtained, the mother-liquors prove to be more alkaline than the normal carbonate. Dalton mentions having obtained a solution of a "sub-tricarbonate," that is, of a salt having three atoms of ammonia to one of carbonic anhydride. Now it seems much less probable that, in these cases, the normal meta-carbonate resolves itself into the acid, or half-acid carbonate, and caustic ammonia, than into one of these salts and the normal ortho-carbonate (or, perhaps, the tri-ammonium ortho-carbonate), thus:—

$$\underbrace{4CO_2(OH_2)_2(NH_3)_2}_{\text{Norm. meta-carb.}} = \underbrace{CO_2(OH_2)_2(NH_3)_4}_{\text{Norm. ortho-carb.}} + + \underbrace{(CO_2)_3(OH_2)_4(NH_3)_4}_{\text{Half-acid meta-carb.}} + 2OH_2.$$

Besides this, unless the mother-liquor from a crop of half-acid meta-carbonate crystals, which is equivalent to, or even more alkaline than, a solution of normal meta-carbonate, be regarded as containing both half-acid meta-carbonate and normal ortho-carbonate, the half-acid salt must be admitted to be quite insoluble in its own mother-liquor.

Ammonium Carbamate.

Besides mixing the dry gases, distilling ammonium sulphamate with anhydrous sodium carbonate (Rose), and passing dry ammonia and carbonic anhydride into absolute alcohol (Kolbe and Basaroff), there are several other ways by which the carbamate can be prepared. By passing carbonic anhydride and ammonia into concentrated aqueous solution of ammonia, the carbamate can be plentifully formed in crystals. By digesting, in a closed vessel, an aqueous solution of ammonia, saturated with the gas at a low temperature, with either the commercial carbonate or any other carbonate of ammonium, at a temperature of 20°—25°, for thirty-six or forty hours, the carbamate is formed, and either crystallises out at once on cooling, or will do so after cooling the solution in ice, charging it afresh with ammonia, adding more carbonate, repeating the digestion as before, and then again cooling. The commercial carbonate yields the most carbamate, as might be expected.

By heating the commercial carbonate with anhydrous potassium carbonate in a retort, the carbamate condenses

in the neck of the retort as a translucent, crystalline incrustation. The same result is arrived at when, instead of potassium carbonate, anhydrous calcium chloride is used. By distilling, extremely slowly, the commercial carbonate by itself, the parts of the product formed farthest from the heat consist almost entirely of carbamate. The product of distilling the normal carbonate by a heat of 60° is nearly pure carbamate. The distillation of the commercial carbonate with strong aqueous spirit also yields an impure carbamate.

Ammonium carbamate occurs in the form of flocculi; of an incrustation more or less crystalline; of prisms found sometimes projecting from this incrustation; of crystalline laminæ (Kolbe and Basaroff); and of well-marked, handsome crystals, neither tabular nor decidedly columnar. Exposed to the air, the carbamate evolves an odour of ammonia, deliquesces, and gradually volatilises almost entirely, the residue being acid carbonate. Although it has a strong physical attraction for water, it only slowly combines chemically with it, especially in the presence of ammonia. Thus, though it deliquesces, very little carbonate must be formed, because so little acid carbonate remains as a residue. Again, it can be obtained in crystals by the union of ammonia and carbonic anhydride in water; it can be dissolved in ammonia-water, and crystallised out again; it can be formed by the dehydration of the carbonate in the presence of water; and it can be a product of distillation along with water. It dissolves, with the sensible production of cold, in about 1½ parts of water; it dissolves unchanged, but soon passes into carbonate; it dissolves in a little more than 2 parts of strong solution of ammonia at 15°. From this solution, it can at first be crystallised out by cold, but after awhile the carbonate crystallises out at ordinary temperatures.

(To be continued.)

DESCRIPTION OF DR. C. SCHIEBLER'S CALCIMETER,

OR APPARATUS FOR THE QUANTITATIVE ESTIMATION OF THE CARBONATE OF LIME IN BONE-BLACK BY VOLUMETRICAL ASSAY.

THIS apparatus is adapted for the estimation of the quantity of carbonic acid contained in native carbonates, as well as in artificial products, and has been specially contrived for the purpose of readily estimating the quantity of carbonic acid contained in bone-black. The principle upon which the apparatus is founded is simply this:—That the quantity of carbonic acid contained in carbonate of lime can, according to well-known stochiometrical rules, be used as a measure of the quantity of that salt itself; and instead of determining, as has been usually the case, the quantity of carbonic acid by weight, this apparatus admits of its estimation by volume, and it is by this means possible to perform, in a few minutes, operations which would otherwise take hours to accomplish, while, moreover, the operator need scarcely possess any knowledge of chemistry. The analytical results obtained by means of this apparatus are very correct, provided care be taken to use all the needful precautions.

The apparatus is shown in the annexed woodcut, and consists of the following parts:—(1). The glass vessel, A, serves for the decomposition of the material to be tested for carbonic acid, which, for that purpose, is treated with dilute hydrochloric acid; this acid is contained, previous to the beginning of the experiment, in the gutta-percha vessel, *s*. The glass stopper of A is perforated, and through it firmly passes a glass tube, to which is fastened the india-rubber tube, *r*, by means of which communication is opened with B, a three-necked tubulated bottle. The central neck of this bottle contains a glass tube, *r*, firmly fixed, which is in communication, on the one hand, with A, by means of the flexible india-rubber tube already alluded to, and, on the other hand, *inside* of B, with a very thin india-rubber bladder (similar, as regards thinness, to the very light and well-known inflated india-rubber balloons sold as toys). The neck, *q*, of the vessel B is shut off during the experiment by means of a piece of india-rubber tubing, kept firmly closed with a spring clamp; the only use of this neck of the bottle, B, arranged as described, is to give access of atmospheric air to the interior of the bottle, if required. The other opening is in communication with the measuring apparatus, C, a very accurate cylindrical glass tube, of 150 c.c. capacity, divided into 0·5 c.c.; the lower portion of this tube C is in communication with the tube D, serving the purpose of controlling the pressure of the gas; the lower part of this tube D ends in a glass tube of smaller diameter, to which is fastened the india-rubber tube, *p*, leading to E, but the communication between these parts of the apparatus is closed, as seen at *p*, by means of a spring clamp. E is a water reservoir, and on removal of the clamp at *p*, the water contained in C and D runs off towards E; when it is desired to force the water contained in E into C and D, this can be readily done by blowing with the mouth into V, and opening the clamp at *p*.

The following apparatus are also supplied with the instrument:—A small and very accurately made weight for weighing off the substances to tested; a thermometer; a bottle with hydrochloric acid; a bottle containing a solution of carbonate of ammonia; several small porcelain basins; and a book of description, with tables for facilitating the calculations.

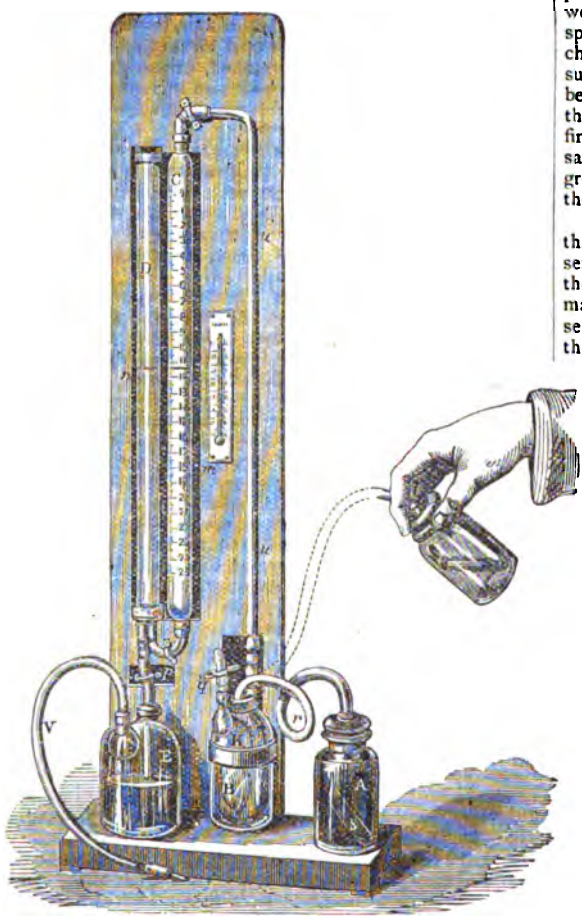
The main portion of the apparatus above described, with the exception. however, of the vessel A, is properly fixed by means of brass fittings to a wooden board, as represented in the woodcut. The filling of the apparatus with water is very readily effected by pouring it through a suitable funnel placed in the open end of the tube D, care being taken to remove, or at least to unfasten, the spring clamp at *p*; in this manner the water runs into E, which should be almost entirely filled. Distilled water is preferable for this purpose, especially as the filling only requires to be done once, because the water always remains in E as long as the apparatus is intended to be kept ready for use. When it is required to fill the tubes C and D with water, so as to reach the zero of the scale of the instrument, it is best to remove the glass stopper from A. The spring clamp at *p* is next unfastened, and air is then blown by means of the mouth into the tube V, which communicates with E; by this operation the water rises up into the tubes C and D, which thus become filled with that liquid to the same height. Care should be taken not to force the water up above the zero of the scale at C, and especial care should be taken against forcing so much of the fluid up that it would run over into the tube *u*, and thence find its way to B, whereby a total disconnection of all the parts of the apparatus would become necessary. If by any accident the water should have been forced up above the zero at C, before the operator had closed the spring clamp at *p*, this is easily remedied by gently opening that clamp, whereby room is given for the water to run off to E in such quantity as may be required to adjust the level of that fluid in C precisely with the zero of the scale. The filling of the tube C with water has the effect of forcing the air previously contained in that tube into B, where it causes the compression of the very thin india-rubber ball placed within B; if it should happen that this india-rubber ball has not become sufficiently compressed and flattened, it is necessary to unfasten the spring clamp at *q*, and to cautiously blow air into B, through the tube, *q*, by which operation the complete exhaustion of the india-rubber bladder placed within B is readily performed. This operation is also required only once, because during the subsequent experiments the india-rubber bladder, K, is emptied spontaneously. It may happen, however, that while the filling of the tubes D and C with water is being proceeded with, the india-rubber bladder, K, has become

fully exhausted of air before the water in c reaches the zero of the scale; in that case the level of the water in the tubes d and c will not be the same, but will be higher in d; it is evident, however, that this slight defect can be at once remedied by momentarily unfastening the spring clamp at *q*.

The apparatus should be placed so as to be out of reach of direct sunlight, and should also be protected against artificial heat, and all sources of heat which might give rise to sudden changes of temperature; the instrument is best placed near a north window, so as to afford sufficient light for reading off the height of the water in the tubes.

The following reagents are required for use with this apparatus:—

Hydrochloric Acid.—The acid required for the decomposition of the bone-black is poured into the vessel *s*



for use during experiments. This acid need not be pure; the crude acid of commerce answers the purpose, provided it be so diluted that its specific gravity at 17° C. is 1·120. It is not even necessary to adhere rigorously to this strength, and for all purposes here required, it is sufficient to mix two parts by bulk of water with one part by bulk of the commercial hydrochloric acid.

Carbonate of Ammonia.—In order to prepare the solution of this salt of the necessary strength, one part by weight of the ordinary carbonate of ammonia of the shops is dissolved in four parts of water, to which one part of liquid ammonia has been added. The salt is first coarsely pulverised, and immediately after placed in a bottle provided with a well ground-in glass stopper; there is next poured over the salt the mixture of water and ammonia, and the solution of the salt promoted by frequent shaking of the bottle. The solution of carbonate of ammonia is used for the purpose of converting into carbonate of lime any caustic lime which might be present in the materials to be submitted to analysis.

Method of Testing Bone-Black for the Quantity of Carbonic Acid it Contains.

Preliminary Operations.—It is of the greatest importance that a good average sample, really representing the entire bulk of charcoal, be taken for investigation; this can be readily obtained by taking, say, from the filter (in sugar works) or from a cask, small samples, say a few ounces, at various depths of the vessels containing the material; or, better still, if there be room, the charcoal should be placed in a heap on a large sheet of stout canvass, and well mixed together, and samples taken from various spots of the heap. These, if wet (as will be the case with charcoal just removed from the filters), should be dried by suitable means, and afterwards the whole sample should be coarsely ground and thoroughly mixed, and a portion thereof taken for the purpose of being ground up to a very finely divided powder, to serve the purpose of weighing a sample from. It is essential that the charcoal should be ground to a very fine powder, because it greatly promotes the decomposition in the apparatus by the acid.

Weighing off of the Sample for Analysis.—We have seen that there is added to the apparatus a metallic weight to serve as normal weight. This weight is placed in one of the pans of balance (when no balance is at hand purposely made for chemical weighing, any balance, provided it be sensitive to from 1-8th to 1-10th of a grain, will answer the purpose); in the other pan a small porcelain basin is placed, and equilibrium is restored by means of small lead shot. As soon as the equilibrium is restored, the normal, or standard, weight is removed from the pan of the balance, and there is placed in the small porcelain capsule and added to the pan as much of the sample of bone-black to be tested as is required to restore the equilibrium. When several experiments have to be made consecutively, it is better to arrange beforehand the joint tare weight of the normal weight, and of a watch glass of suitable size, and to weigh off upon the latter the several samples. The author recommends the transference of these weighed quantities to a porcelain capsule, because, according to his plan, the samples, *after* having been weighed, have to be thoroughly moistened with the solution of carbonate of ammonia already referred to, in order to convert any caustic lime which might happen to be present in the material into carbonate of lime; but we think it is a decided improvement to moisten gently with the aforesaid solution of carbonate of ammonia a sufficient quantity of the samples to be tested previous to weighing them; to dry these, as also directed by Dr. Schiebler, and to apply at last, for a few moments, a stronger heat short of red heat (say an air or fusible metal bath, heated to 240° C.), so as to obviate the chance of either an excess of carbonate of ammonia or of water being present, while, at the same time, the decomposition of the carbonate of lime is guarded against. After the samples are quite cold, they are to be transferred to the flask or bottle A. The author states that more recent researches have proved that bone-black which has been once used for filtering purposes in sugar works no longer contains any caustic lime, and the treatment with carbonate of ammonia can therefore be dispensed with in that case, and need only be employed with samples freshly made.

The experiment for the quantitative estimation of the carbonic acid is carried out in the following manner:—First the water in the tube c is made to stand exactly at the zero (0) of the scale; next the weighed sample of the bone-black to be tested is transferred with great care and without loss, to the bottom of the bottle, A, which should be perfectly dry inside and quite clean. This having been

done, the gutta-percha vessel, *s*, which should also be previously well cleaned, is filled with the hydrochloric acid above referred to, to within from ¼ to ½ inch from the top, care being taken not to drop any hydrochloric acid on the outside of that vessel; this gutta-percha vessel is next placed within the bottle A in a slanting direction, as shown in the woodcut; after this the glass stopper is replaced on A, care being taken to slightly grease it and the inside of the neck of A, thereby securing a better air-tight fitting. The closing of A will (if all parts of the apparatus are properly tight) have the effect of slightly lowering the level of the water in C, below the zero of the scale, while the water will rise just as much higher in D; by unfastening, for a moment, the spring clamp at *q*, the normal height is properly restored. The operator should very carefully guard against handling or touching A after it has been once closed, because, by so doing, the warmth of his hand will cause the expansion of the air in A, and thereby affect the proper action of the apparatus. In order to cause the hydrochloric acid contained in the gutta-percha vessel placed inside A to run on to the animal charcoal, placed on the bottom of A, as described, the flask or bottle A is taken hold of by the neck, as delineated in the woodcut. As soon as the acid comes into contact with the bone-black, the evolution of carbonic acid gas begins, and with it also the expansion of the very thin india-rubber bladder, K, while the water in the tube C sinks, and correspondingly rises in D. While the bottle A is held in the right hand, as already indicated, and gently moved about so as to promote, as much as possible, the contact between the acid and the charcoal, the left hand is employed to gently open the spring clamp, *p*, in such a manner as to run off towards B just as much water as is required to keep the level in the tubes C and D at the same height; both these manipulations should be continued as long as any sinking of the level of the water in C is perceptible; in other other words, as long as any carbonic acid is given off. After this has quite ceased, and no change is perceptible, or any motion of the water in the tubes, just alluded to, has taken place, the operation may be considered at an end, care being taken, however, to keep the levels in the tubes C and D at precisely the same height. This having been done, the next step is to read off the height of the water at the scale on C, and simultaneously the thermometer.

EXPERIMENTS ON BUNSEN'S FILTER PUMP.*

By ROBERT H. RICHARDS, M.E.

IN the summer of 1869 I was asked by Professor Storer to put up Bunsen's filter pump for the laboratory of the school. In complying with his wishes I have been led to try a number of experiments upon the most efficient form of pump, and have arrived at some conclusions which seem to be worth recording.

It is evident, *à priori*, that an even flow of air and water is necessary, in order to obtain the best results, otherwise the tension of the air inside the partially exhausted vessel will not be constant. The bubbles of air should be round rather than elongated, should be uniformly distributed throughout the entire length of the column of water, and of no smaller diameter than the pipe itself, for if the bubbles are of less diameter than the pipe they will continually flow upwards through the water, and thus a portion of the useful effect of the water would be lost; and if the bubbles are much longer than the diameter of the tube, the vertical column of falling water may be much diminished in length.

In each of the figures (Figs. 1, 2, 3, 4, 5), *a* represents the air-tube, or the tube through which the air is drawn into the pump; and *f* represents the tube through which the water is fed to the pump.

In the pump described by Bunsen, Fig. 1 (CHEMICAL NEWS, vol. xix., p. 160), I find no small difficulty in adjusting the end of the tube, *p*, so that the above conditions may be fulfilled. I have worked with four different pumps of this pattern, but have never obtained a completely satisfactory result for all rates of speed of flow. At times, when the rate of flow was small, a bubble or air space as much as a foot long would collect just below the pump.

After experimenting for some time with the form Fig. 1, I tried the form Fig. 2, in which the water flows through a tube of uniform bore throughout its entire length, and the air is drawn in through a small aperture in the side of the tube. By this arrangement the result sought for is attained very fairly, the tube being filled with the desired even mixture of bubbles of air and water. Fig. 3 represents a simpler form of the same apparatus, which affords equally good results, and which now receives preference to other forms in the laboratory of the Institute of Technology.

Some time after I had devised this form of pump, I observed that Sprengel (CHEMICAL NEWS, vol. xvii., p. 85) had previously described a similar tube to be used as an aspirator. It should be observed that Sprengel's aspirator is worked by pressure of a column of water, which has not yet entered the apparatus, while in Bunsen's arrangement the power is derived solely from the column of water which has passed the point at which the air and water mix.

The idea subsequently occurred to me that the bubbles might be delivered more evenly and of uniform size if the air were made to bubble up through water contained in a little reservoir, as in *e*, Fig. 4. I find, in fact, that in passing through the water in the reservoir, *e*, the air naturally breaks up into bubbles of uniform size and shape. The same result may be accomplished just as well by the somewhat simpler arrangement, Fig. 5, in which the enlargement, *e*, is dispensed with, but the position is maintained.

The mode of working of this apparatus is probably as follows:—The feed water tends to flow up the air-tube, *k* (Fig. 5), but is met by the air which is being drawn in by the column of water in the waste-tube and is thus forced back for a moment so that a bubble of air is delivered into *i*; the water then rushes up again towards *k*, and is again forced to retreat so as to allow another bubble of air to pass. A continual oscillation between air and water evidently occurs at this point.

I have made several pumps of the form represented in Fig. 5, of tube varying in size from ¼-inch bore to ½-inch, taking care that the air-feed and waste-tubes in each one of the several pumps should be, as nearly as possible, of the same, and I find that even the pump of ¼-inch bore will yield bubbles of equal size and equally distributed when the supply of air is checked as would be the case when used to exhaust air from a vessel, or when the air is fed into the pump through a small orifice. In this form of apparatus, Fig. 5, the water has no tendency to flow down the walls of the tube, so as to leave elongated air spaces in the centre.

The great advantage of Figs. 3 and 5, is the ease with which they may be made, a single T-joint forms the whole essential part of the construction, but in Fig. 1 the end of the tube at *p* must be carefully adjusted, otherwise the water cannot be allowed to flow at a very slow rate. Fig. 3 will answer well for pumps ¼-inch in bore or less, but the form Fig. 5 should be used for any pump larger than ¼-inch. Fig. 5 represents the only form of pump which, when of a bore much exceeding ¼-inch, seems to be capable of taking down air in the form of bubbles; hence it is the form to be used, if this principle is ever applied on a manufacturing scale in chemical works, in procuring a vacuum for pumping mines, &c.

* Communicated by the Author.

The following experiments were performed rather with a view to explore the subject than with any definite purpose. My apparatus was faulty, the tubes were of the best glass tubing I could find; but glass tubes are, more or less, conical. The connections were all made of caoutchouc tubing made air-tight with shellac. With the large pump, I think the error in starting and stopping the experiment does not exceed 100 c.c. of water; with the small one the error could not amount to 10 c.c.

In the experiments with the ¼-inch bore pump, up to 15 litres of water were used in an experiment; in experimenting with the ¼-inch pump, up to two litres; with the ½-inch pump, up to 1200 c.c. In the tables here given the water is used as the standard of comparison, and the other elements are reduced in the right proportion.

The first column in the tables, marked height of water column, represents the measurement of the whole fall of water. The second column represents the height of mercury corresponding to that amount of water. The third column, marked P, shows the height of mercury in the manometer, which, in any experiment, if the air be stopped, the water is capable of counterpoising, when it is flowing through the pump at the rate shown by the corresponding water and time columns. The fourth and fifth columns show respectively the amount of water and air which were collected at the foot of the waste-tube, in the time represented in the sixth column.

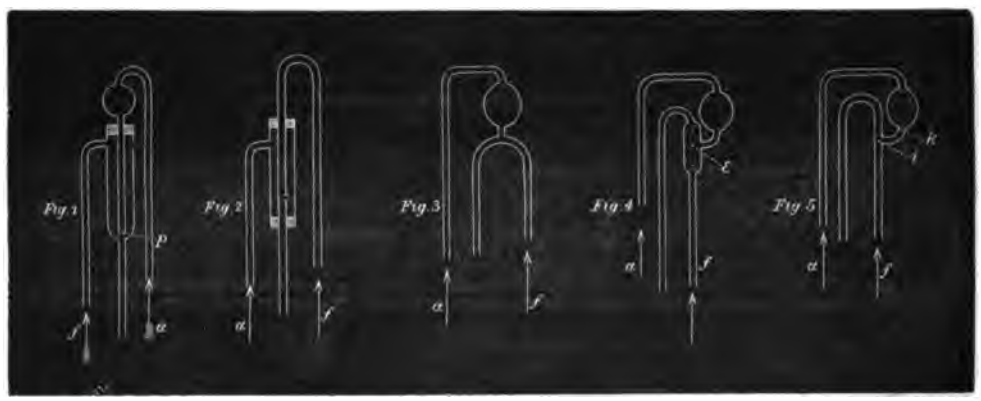
Experiment 29 was tried four times, but failed on account of the very small power of the water to carry down air when flowing at that rapid rate.

Results of Experiments performed with ¼ inch Bore Pump

	Height of column of water.	Corresponding column of mercury.	P.	Water.	Air.	Time.
	m.	m.m.	m.m.	c.c.	c.c.	m. s.
13.	2·36	174	169·0	1000	3402	5 52
14.	,,	,,	164·0	,,	1561	1 42
15.	,,	,,	160·0	,,	1286	1 25
16.	,,	,,	151·0	,,	861	1 1
17.	,,	,,	134·0	,,	449	0 41
18.	,,	,,	112·0	,,	181	0 29
19.	,,	,,	92·0	,,	85	0 25
20.	,,	,,	70·0	,,	14	0 21
21.	,,	,,	0	,,	0	0 15

Results of Experiments performed with ½ inch Bore Pump.

	Height of column of water.	Corresponding column of mercury.	P.	Water.	Air.	Time.
	m.	m.m.	m.m.	c.c.	c.c.	h. m. s.
22.	2·385	175	170	1000	48,142	12 41 0
23.	,,	,,	172	,,	4,280	0 22 0
24.	,,	,,	155	,,	1,610	0 8 28
25.	,,	,,	120	,,	376	0 3 29
26.	,,	,,	92	,,	138	0 2 38
27.	,,	,,	73	,,	87	0 2 29
28.	,,	,,	51	,,	31	0 2 15
29.	,,	,,	23	(Failed four times.)		
30.	,,	,,	0	,,	0	0 1 59



Results of Experiments performed with the ¼ inch Pump, all Reduced to the Standard of 20 litres.

	Height of column of water.	Corresponding column of mercury.	P.	Water.	Air.	Time.
	m.	m.m.		c.c.	c.c.	m. s.
1.	3·05	224	219	20,000	36,374	10 26
2.	,,	,,	219	,,	32,454	7 25
3.	,,	,,	217	,,	29,501	5 45
4.	,,	,,	214	,,	30,133	5 22
5.	,,	,,	208	,,	31,251	5 29
6.	,,	,,	200	,,	29,501	4 31
7.	,,	,,	189	,,	16,287	2 40
8.	,,	,,	179	,,	12,229	2 11
9.	,,	,,	157	,,	8,522	1 51
10.	,,	,,	130	,,	4,802	1 31
11.	,,	,,	84	,,	1,187	1 9
12.	,,	,,	0	,,	0	0 51

If a curve be drawn having the various times above for its abscissas, and the corresponding height of mercurial column from column P for its ordinates, there will be found an irregularity in the curve along by Experiments 4, 5, and 6; this I believe to be owing to defects in the tubing. There is nothing of the kind to be seen in either of the other sets of experiments.

We see, at once, by these experiments, that the longer the time taken to run a given amount of water, or, in other words, the slower the stream, the more air it is capable of carrying down, and the more it is capable of raising the mercurial column when the air is stopped.

The capacity of the pump might be discussed as follows:—

Let P = the number of pounds on the square inch due to H = the total fall of water.

Let r = the ratio of the volume of water in the tube at any time to the whole volume of the tube.

Let h = the useful fall of water.

Then $h = Hr$, and $P = H \times \frac{14{\cdot}7}{32}$ (for every vertical foot of water represents $\frac{14{\cdot}7}{32}$ lbs. of pressure per square inch), but P is never realised, for we never have H, height of water, but Hr; hence, without considering other losses, the power $= p = Hr\frac{14{\cdot}7}{32}$ lbs. per square inch; and since r appears in the numerator it is evident, that other things being equal, the more water and the less air the more will be the tension. Loss of power is also due to the retarding influence of friction, f, upon the falling stream, and also is due to the flow of the feed stream. Suppose

the air is allowed free passage, and, under these circumstances, if the velocity in the waste-pipe = 20 feet per second, and that in the feed-pipe = 18 feet per second, we should have a difference = 2 feet per second, which is all that is useful in pulling down air, and which 2 feet per second is due to a fall of only about an inch; by allowing the above rate of speed we should reduce our effective head to 1 inch = h.

Let v = useful velocity.

Let v_1 = velocity of waste.

Let v_2 = velocity of feed.

Then $v = v_1 - v_2$,

or the smaller v_2 is and the larger v_1 the greater will v be; hence, the greatest exhaustion is obtained by turning the feed water off entirely, provided the waste-pipe is full, and, as a rule, the slower the rate of flow the more power due to this cause.

To collect our data we have:—

No. 1. The more water and less air in the waste-tube the more tension.

No. 2. Friction increases with velocity of flow; hence, the slower the stream the more the power.

No. 3. The slower the rate of speed of feed-water the more power. (This follows from 2).

No. 1 may be seen practically in a moment at the pump; thus the water is turned on, and as soon as the waste-pipe is filled with bubbles of air and water the air opening is stopped, the manometer at once begins to rise, and continues to do so until no more bubbles are seen in the waste-tube, when the manometer will stand still and give the maximum exhaustion due to the head, with the rate of speed used.

No. 2 can also be seen in a moment, for the feed can be turned on fast enough to stop all air from coming in when the air has free admission, and, in fact, to force the water back up the air-tube, which would not be true to the laws of falling bodies if it were not for friction.

No. 3 is exemplified thus:—In experiment under No. 1, when the waste-pipe has no air bubbles in it, and is being steadily fed with water, the speed of the feed-water is suddenly increased; the manometer will go down a little if, on the other hand, the feed is partially cut off or its speed checked; a few air bubbles will go down the waste-tube and the manometer will rise; the manometer will be found at its maximum when the waste-pipe is full of water and the feed is entirely cut off.

Next, it is evident that these results conflict with each other, or that there is some point at which a maximum effect can be obtained, though not quite maximum tension nor volume of air per volume of water.

For instance, look back to Experiment 15. We find 1100 c.c. of water carried down 1286 c.c. of air in 1 min. 25 secs. Also look at Experiment 13, 1000 c.c. of water carried down 3402 c.c. of air, but took 5 min. 52 secs. to do it. I think we should find the rate of speed used in Experiment 15 very much more advantageous than that in 13, for the former would carry down very much more air per minute and with very slightly decreased power, as shown by column P.

I have not yet had time to try similar experiments with the form Fig. 1. Very probably the difference between two pumps, one of which delivers its air evenly while the other does not do so, may be small and in fact may, perhaps, be hard to discern in the practical use in the laboratory; still we should use the tools which theoretically work the best, provided no fault can be found with them in practice.

When the platinum cone was tried as represented (Chemical News, vol. xix., p. 160), it was found to clog with a very small amount of precipitate; the same cone was punched with a large number of holes $\frac{1}{10}$ of an inch in bore or thereabouts, and the liquor ran through much faster. It was then observed that the precipitate always collected upon that portion of the filter which was in immediate contact with the platinum cone much more than anywhere else, and, therefore, that the liquor ran through the paper mostly where it was in contact with the platinum, and hence, it seemed probable that the larger the cone the more quickly would the filtration be performed. A cone was then made 1¼ inch in slant height, and punched with the same sized holes, and the water was found to run through very much faster than before. I find that this cone for quickness and for safety is much better than any I have tried; it can be put into any common funnel, no matter how imperfect.

I found that when the filter pump was not used, that I could filter much faster with the large cone under my filter than without it, which exactly corroborates Avery's experiments (*American Journal of Pharmacy*, May, 1868, and also the observation of R. Dale, in the Chemical News, vol. xx., p. 128).

Mass. Institute of Technology,
Boston, June, 1870.

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

(Continued from p. 66).

Various Aniline, Phenol, and Naphthalin Colours—Application of the Coal-Tar Colours to the Arts.

Last lecture we considered, among other subjects, magenta and some of its coloured derivatives, as the blues and violets. This evening we commence with some of the green colouring matters which have also been produced from magenta. The first green colouring matter we shall consider is the "aldehyd green," which owes its name to a substance called "aldehyd" being employed in its preparation. I must, therefore, first tell you what aldehyd is.

Aldehyd is a product of the oxidation of alcohol; it is a volatile liquid possessing a very peculiar odour, and was discovered by a chemist named Döbereiner, but analysed by Liebig. It is obtained by treating alcohol with a mixture of bichromate of potassium and sulphuric acid, and was generally prepared in glass retorts, but, now that it is required for colour making, the glass apparatus is replaced by copper or leaden vessels.

Towards the end of 1861, M. Lauth described a reaction by which rosaniline could be made to produce a blue colouring matter; but this product was found to be useless as a dye, on account of its instability. It was produced by the action of aldehyd upon a solution of rosaniline and sulphuric acid. This useless colour was afterwards experimented upon by a dyer named Chirpin, who, after a number of fruitless attempts at fixing it, told his difficulties to a photographic friend, who evidently thought if it was possible to fix a photograph it was possible to fix anything else. He, therefore, advised his confidant to try hyposulphite of sodium. On making this experiment, however, the dyer did not succeed in fixing his blue, but found it converted into a splendid green dye, now known as aldehyd green.

To prepare this colouring matter, a cold solution of magenta, consisting of one part of colouring matter dissolved in a mixture of three parts of sulphuric acid, and one part of water, is employed; about one and a half parts of aldehyd are added by degrees to this solution, and when the whole is mixed it is heated on a water bath, until a drop of the product diffused in water produces a fine blue colouration. It is then poured into a large quantity of boiling water, containing three or four times as much hyposulphite of sodium as the magenta employed. After boiling a short time the product is filtered off from a greyish insoluble residue which forms. The filtrate contains the green. This process being a very simple one, a

* The Cantor lectures, delivered before the Society of Arts.

great number of dyers now prepare the colouring matter as they require it. It may, however, be precipitated by means of tannin or acetate of sodium, collected on filters and drained to a paste, and, if necessary, dried. In both these forms it is found in the market.

The aldehyd green is principally employed in silk dyeing. It is a splendid colour, and very brilliant both by day and artificial light. The chemistry of this green is at present hidden in obscurity, as it is very difficult to obtain in a chemically pure condition. But like the colouring matter previously described, it is undoubtedly the salt of an organic base apparently containing sulphur.

This base is colourless, or nearly so, and becomes changed to the normal colour of aldehyd green upon absorption of carbonic acid.

It will also decompose ammonia salts, combining with the acid and becoming green. I have here a solution containing the colourless base of this green, an ammonia salt and a little free ammonia. If I pour it upon a piece of white blotting-paper it does not stain it, but if I heat it the ammonia salt is decomposed, and we get the green developed with its ordinary intensity.

There is another green of an entirely different nature to the aldehyd green; it is called the iodine green. This colouring matter is always produced, but in variable quantities, in the preparation of the Hofmann violets, from magenta and iodide of ethyl or methyl. Of late, much attention has been directed to this colouring matter, and by making a few alterations in the process for preparing the Hofmann, from forty to fifty per cent of product can now be obtained from the magenta used. The iodine green is much used for cotton and silk dyeing; its colour is bluer than that of aldehyd green, and it is, therefore, more useful, as it yields, with the addition of yellow, a greater variety of green shades.

Iodine green contains an organic base which is not precipitated by alkaline carbonates. With picric acid it forms a difficultly-soluble picrate, and is generally prepared on the Continent as a paste consisting of this colour precipitated with picric acid and drained on a filter. In England it is, however, sold in alcoholic solution. It is a good green by gaslight.

The next green I have to bring before you is a magenta derivative, commercially called "Perkin's green." In its properties it resembles more closely the iodine than the aldehyd green, but differs from this in its solubility, and in being precipitated by solutions of alkaline carbonates, as carbonate of sodium. It is an organic base which is nearly colourless, and is by no means a chemically powerful body. Like the iodine green, it is precipitated by picric acid, forming a picrate which crystallises from alcohol in small prisms with a golden reflection. This colouring matter is principally employed for calico printing, and is now extensively used. Thus you see we have three aniline greens, some useful for one, and some for another purpose, so that the silk and cotton dyer, and the calico-printer, as well as others can be supplied. For fastness these greens are, I think, quite as good as the violets; the aldehyd green, however, I believe, resists light the best.

In the formation of the mauve, or aniline purple, there is always a small quantity of a second colouring matter produced, of a rich crimson colour, similar to that of safflower. Several years ago I examined this substance, and found it to dye silk a remarkably clear colour, but owing to the press of other matters, and the very small quantities in which it could be obtained, I did not give it any further attention. By a new process, however, it can now be produced in somewhat larger quantities, and endeavours are being made to introduce it to the arts, as it produces beautiful tints of pink upon silk and cotton, and, moreover, can be used for printing cotton, silk, and wool processes, to which safflower cannot be applied as it will not bear steaming. This aniline pink or crimson is a beautiful chemical body, crystallising in small prisms, possessing a golden green lustre. It is soluble in alcohol, and also in water; it produces solutions remarkable for their fluorescence, so much so, that by certain lights they appear as if filled with a precipitate. In colour and fastness it is equal to safflower, and should it be found possible to manufacture it at a moderate price, I should imagine it would entirely supersede that colouring matter, especially as it is not affected by alkaline solutions.

There is a product in the English market supposed to be an aniline colour called "Field's orange," after its discoverer, Mr. Frederick Field. Its properties are those of a nitro-acid, but as its preparation has not been described, of course I cannot tell you anything about it. With alkalies it forms a rich orange-coloured solution, but by the addition of an acid it is precipitated as a pale yellow powder.

Field's orange is a very useful colouring matter, having a great affinity for animal fibres, and is extensively used for wool-dyeing, as it resists the action of light very well.

We now come to a colouring matter of a very indefinite nature. I refer to aniline black. This substance appears to be closely allied to the insoluble part of the black precipitate formed in the manufacture of the mauve. This precipitate, however, always contains oxide of chromium, which cannot exist in the aniline black generally employed, as no chromium compound is used in its preparation, but as copper compounds are used, it may be that aniline black represents the black precipitate with the oxide of chromium replaced by the oxide of copper, or it may even be that in either case the metallic oxide is not an essential part of this black substance.

Aniline black is perfectly insoluble, and has, therefore, to be formed upon the fibre when employed for calico printing. As we shall have to refer to its application to dyeing and printing, I will not make any further remarks upon it just now.

From mauve and magenta, chocolate maroons and browns are prepared, but, as they are of secondary importance as yet, I will only just mention one or two of the methods of preparing them.

One of the processes for preparing chocolate from magenta is by the action of nitrous acid, but care has to be taken to watch the progress of the operation, and to stop it when the required shade has been obtained. Another process consists in heating magenta with hydrochlorate of aniline to a temperature a little above 200° C. The product, when purified, produces a maroon colour. Browns are generally obtained from the residue of magenta making.

All the colouring matters we have considered up to the present time are derivatives of aniline and toluidine, and constitute nearly all the colours of the rainbow.

By the action of nascent hydrogen upon dinitrobenzol, Mr. A. H. Church and myself obtained, in 1857, a crimson colouring matter, which was named nitrosophenyline. I have lately made a few new experiments upon this remarkable body, and find that it has an affinity for pure cotton, dyeing it of a clear cerise colour, considerably less blue in tint than safflower. With very dilute acids, this colouring matter forms a blue solution; with less dilute acid, a crimson colour, and with concentrated sulphuric acid a green colour. It is difficult to judge of the probable utility of this colouring matter, as it is so difficult to obtain in quantity by the present process. I may mention that my new experiments with this substance have caused me to doubt the purity of the product examined by Mr. Church and myself; and this is not remarkable when we consider how few methods of purifying artificial colouring matters were known at the date of our experiments, as well as the small amount of substance at our disposal.

We now turn to a product very different from aniline, though related to it in some respects very closely. On the table you will see a coal-tar product called "phenol," or "carbolic acid." It was discovered, a long time since, by Runge, and afterwards studied by a great number of chemists. It is only, however, during the last few years, that it has been introduced into commerce in a pure con-

dition, thanks to Dr. Crace Calvert, so well known to the Society of Arts.

Phenol or carbolic acid is a splendid crystalline body, possessing many most interesting properties; but I must confine myself to a short account of its coloured derivatives only.

Carbolic acid, when treated with nitric acid, yields a yellow acid, known as picric acid. This substance can be produced from many other bodies besides carbolic acid, and when first employed for dyeing purposes was generally prepared from the resin of the *Xanthorrhea hastilis*, but now, owing to the cheapness and purity of carbolic acid, I believe it is exclusively used in its manufacture. Picric acid requires care in its preparation, if phenol and strong nitric acid be employed, as the action is very violent. Pure picric acid is of a very pale yellow colour; it is employed principally for silk dyeing, the colour it produces on silk being much darker than that of the acid itself. Picric acid has a very bitter taste, and by some it is said to be a great improvement upon hops, in the manufacture of bitter beer, especially as it has been proposed as a tonic in place of quinine. Picric acid forms beautiful yellow salts, the most interesting being that of potassium. This salt is extremely insoluble in water, and very explosive; it has been proposed as a substitute for gunpowder for charging shells. Picric acid, under the influence of cyanide of potassium, is perfectly decomposed, and changed into a new compound called isopurpuric acid, a substance isomeric with murexide. The potassium salt of this compound is very explosive, and, to avoid danger, it is generally supplied in a moist condition, and mixed with glycerine. It produces a kind of maroon colour upon wool, but I do not think it has been extensively used up to the present.

Runge, when experimenting with the products of the distillation of coal, obtained two compounds, called by him rosolic and brunolic acids, which he regarded as products existing in coal-tar; I think it most probable, however, that these bodies were produced in his process of purification, and did not exist ready formed in coal-tar.

Rosolic acid was afterwards examined by Dr. Hugo Müller, who obtained it from crude carbolate of calcium, which had been exposed to the oxidising action of the air. This process, however, does not yield rosolic acid in quantity, but, in 1861, Kolbe and Schmitt described a method of producing this substance, by heating a mixture of oxalic, carbolic, and sulphuric acids. It is stated, however, that this process was discovered by M. Jules Persoz, in 1859. It is by this method that rosolic acid is now manufactured.

Commercial rosolic acid, commonly called aurine, is a beautiful brittle resinous substance, having a slight green metallic lustre; when pure it may be crystallised, and if pulverised forms a scarlet orange powder. Its solutions are of an orange colour, but change with alkalies to a most magnificent crimson. It has not been found capable of very many applications in dyeing and printing, although it produces very good orange shades, and with magenta it makes a very good scarlet.

The great difficulty in applying rosolic acid to the arts is owing to the easy solubility of its salts in water. It appears to be closely allied to rosaniline, as it has lately been found possible to obtain it from this colouring matter.

When heated with ammonia, in a closed vessel, to 120° or 140° C., rosolic acid permanently changes into a new colouring matter of a crimson shade, called "peonine" or "coralline." It forms beautiful tints upon silk, similar to safflower, provided it is kept slightly alkaline, but if treated with the least quantity of acid the freshness of its colour is destroyed. When heated with aniline this colouring matter undergoes a similar change to magenta, being converted into a blue called azuline. This colouring matter, as well as coralline, was discovered by M. Jules Persoz, and patented by MM. Guinon Marnas and Bonnet in 1862. Azuline, when in the solid state, presents a coppery coloured surface; it is soluble in alcohol, bu difficultly so in water. It is not manufactured now, having been replaced by the more brilliant blues obtained from rosaniline, and described in our last lecture.

We must now turn our attention to another series of coal-tar colours, derived from a beautiful product called naphthaline. You will see it on the table of coal tar products; it is a hydrocarbon containing $C_{10}H_8$, and may be obtained in any quantity. It is remarkable for the readiness with which it sublimes, and, like benzol and toluol, it yields with nitric acid a nitro compound called "nitronaphthaline," a beautifully crystalline body, and this, with iron and acetic acid, yields an organic base called "naphthylamine." This base is solid, and beautifully crystalline, but possesses a very disagreeable odour.

Mr. Church and myself obtained from a salt of "naphthylamine" and a mixture of nitrite of potassium and potash, a beautiful substance crystallising in orange needles with a green lustre. It is called by a rather long name, "azodinaphthyldiamine."

This substance is a feeble organic base, and dissolves in alcohol, forming an orange-coloured solution, which changes to a splendid violet colour upon the addition of hydrochloric acid. It has, however, been found useless as a dye, because the purple colour only exists in the presence of free acid, and the orange-colour of the base itself is liable to turn brown when exposed to the light. It would appear probable, however, that azodinapthyldiamine may become useful as the starting-point for new colouring matters, as I have lately succeeded in producing from it a very promising crimson substance, possessing a considerable affinity for animal fibres.

A very beautiful yellow colouring matter has been obtained by Dr. Martius from naphthylamine, somewhat similar to picric acid, but of a much more intense colour. It is prepared by treating hydrochlorate of naphthylamine with nitrite of potassium; by this means a substance known as diazonaphthol is obtained; this is then heated with nitric acid, and is transformed into the new yellow, chemically known as dinitronaphthol. This substance is commercially called Manchester yellow. It possesses the properties of an acid. The commercial compound consists of a beautifully-crystalline calcium salt, soluble in water, and dyeing silk or wool a magnificent golden yellow colour.

Owing to an increasing demand for benzoic acid, experiments have lately been made with a view of obtaining it from naphthaline instead of gum benzoin, &c. For this purpose experiments were made with an acid derived from naphthaline, called phthalic acid, which, when carefully heated with lime, is found capable of yielding benzoate of calcium, from which benzoic acid can be prepared. But as in these processes secondary compounds are formed, which interest us this evening, I will briefly describe the process employed for obtaining these various substances.

First of all, naphthaline is heated with a mixture of chlorate of potassium and hydrochloric acid; in this way a mixture of chloronaphthaline and bichloronaphthaline is obtained. These products are then heated with nitric acid, and yield a mixture of phthalic acid, and a substance called the chloride of chloroxynaphthyl. The phthalic acid is converted into the calcium salt, and heated with slaked lime to a temperature of 350° or 370° C., to convert it into a benzoate.

It is, however, the chloride of chloroxynaphthyl which interests us now. This substance, when heated with an alkali, yields the salts of an acid called chloroxynaphthalic acid, which may be obtained in a free state by means of hydrochloric acid. When pure, chloroxynaphthalic acid is a pale yellow crystalline powder, forming beautiful compounds with baryta, zinc, and copper. It dyes wool a scarlet colour. The great interest of this substance consists in its supposed relationship to alizarine, the colouring matter of madder, the only difference in composition of chloroxynaphthalic acid and alizarine being

in the former containing an equivalent of chlorine in place of hydrogen, thus :—

$C_{10}H_6O_3$ .. .. .. Alizarine.
$C_{10}(H_5Cl.)O_3$ .. .. Chloroxynaphthalic acid.

Many endeavours have been made to remove this chlorine, and to put hydrogen in its place, with the hopes of producing alizarine; but, up to the present time, no definite results have been obtained.

I am inclined to think that, although this relationship of composition exists between these bodies, yet that their chemical nature is quite dissimilar, We generally find that chlorinated bodies have similar properties to those from which they are derived or represent. Chloroxynaphthalic acid, however, does not appear to possess properties similar to alizarine. This acid dyes wool readily without a mordant; alizarine only slightly stains it. When boiled with cloth prepared with alumina or iron mordants, it scarcely produces any change, while alizarine yields intense colours.

This process of preparing benzoic and chloroxynaphthalic acids is carried out on the large scale in France, by MM. P. and E. Depouilly, to whom I am indebted for the specimens of these products shown in this lecture. Some of the chloroxynaphthalates are beautifully-coloured salts, and are used as pigments.

Laurent in his researches obtained a body from naphthaline, called carminaphtha. This product is now claiming the attention of manufacturers, and is said to produce very fine shades of colour upon fabrics.

(To be continued.)

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 1st 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences :—

Spectrum of the Solar Atmosphere.—G. Rayet.

Thermo-Chemical Researches on the Sulphurets.—M. Berthelot.—This lengthy memoir is divided into the following sections :—Reactions of alkaline sulphides upon solutions of metallic salts; reactions of acids upon alkaline sulphides; reaction of sulphuretted hydrogen upon divers metallic salts; and reaction of acids upon metallic sulphurets.

Action of Pentachloride and Pentabromide of Phosphorus upon Divers Ethers.—L. Henry.—This memoir is divided into the following chapters :—Glycollate and lactate of ethyl; diethylic malate and tartrate. The author says that, while hydroxyl, (HO), no matter what be its function (be it that of alcohol, acid, or phenol), is readily replaceable, often even at the ordinary temperature, by an atom of chlorine or bromine, under the action of pentachloride or pentabromide of phosphorus. The methoxyl and ethoxyl are not so acted upon. The author's memoir is too lengthy for further useful abstraction, exceeding even the limits usually permitted for publication of papers in this periodical.

Analysis of Nadorite, a New Kind of Mineral from Constantine (Algeria).—F. Pisani.—The author of this paper begins by referring to M. Flajolot's paper on this subject (see Chemical News, vol. xxii., p. 58); and next states that the last-named experimenter has overlooked the presence of chlorine in this mineral. The results of the analysis made by M. Pisani are, in 100 parts—Oxide of antimony, 37·40; oxide of lead, 27·60; lead, 26·27; chlorine, 9·0. Formula, $(Sb_2O_3,PbO)+PbCl$. Nadorite is, therefore, a new and rather remarkable mineral, since it is the first instance that chlorine has been found in a native compound containing antimony. Nadorite is accompanied by a lemon-yellow coloured mineral, which turned out to be an antimoniate and hydrated carbonate of lead.

Hygienic Use of Phenic Acid.—Dr. F. C. Calvert.—The contents of this paper are sufficiently well-known, but there is added to it a foot-note from the hand of M. Dumas, who says that phenic acid has been used as disinfectant, on the large scale, since 1865; in the following year, its use was made compulsory wherever any death occurred, and at all funerals. The hygienic use of this substance is, therefore, far longer established in France than in this country, where, according to the author of the paper above alluded to, it has only been introduced since 1867.

Quantity of Pure Nitrogen given off by Organic Nitrogenous Substances.—Dr. F. C. Calvert.—This paper contains the results of some experiments on the action of hypochlorous acid upon animal matters. The quantity of nitrogen present in these substances is—For gelatine and albumen, 15·7 per cent; calcine, 15·8 per cent; and wool and silk, respectively, 17·7 and 17·6 per cent. The quantity of nitrogen evolved from these substances by the action of hypochlorous acid varies from 5·391 to 7·81 per cent.

Maximum of Temperature at Poitiers on the 24th of July, 1870.—Ch. Contejean.—The author says it very rarely happens that, in this part of France, the temperature exceeds 35° (95° F.) in the shade, and towards the north quarter of the sky; but on the above-named date, the temperature has been, for several hours, 41° (above 106° F.), and during that time the curious phenomenon could be witnessed of a falling of the mercury in the thermometer, if the bulb thereof were touched by the fingers, or placed in the mouth. The sky was quite bright and clear, and the wind N.E. The city of Poitiers (Departement de Vienne) is situated at between 46° and 47° N. latitude, and at about 2° W. of Paris.

Rainfall on the French Alps.—V. Raulin.—There are added to this paper a series of tabulated forms exhibiting the results of meteorological observations made at sixteen different localities, varying in height, above sea level, from 2491 to 213 metres; while, in every single locality, the observations have been carried on for a great number of years. It is curious to learn that, whereas, in the Pyrenees, the annual rain-fall increases with increase of height above sea level, the reverse occurs in the French Alps, where, on the whole, the quantity of rain which falls is less.

Earthquake in Mexico on the 11th of May last.—Dr. Chassin.—The author describes, at great length, a series of earthquakes which have taken place from the 11th to the 19th of May last in the western part of the above-named country. That portion were this phenomenon was most active has, it appears, undergone very curious changes. Lake Chicagua has entirely disappeared, leaving a dry soil, with the fish, alligators, and other aquatic animals on it. In other places, Cayula among the number, a new lake has been suddenly formed; old, deep wells, which were dry years since, have become filled with water again, and other wells have run dry. Trees have been uprooted by thousands, and whole villages have disappeared.

Cotton Respirators.—Dr. Jouglet.—The author, taking the hint thrown out by Professor Tyndall, has been experimenting on the use of cotton respirators, and states that, by their application, the disease known as miner's anæmia, and also the dangers of the effects of lead, copper, and mercury, to those who have to handle these metals, or work in vapours or dust thereof, may be prevented.

Annalen der Chemie und Pharmacie, June, 1870.

This number contains the following original memoirs and papers :—

Carbonic Acid Ether of the Glycolic Acid Ether.—W. Heintz.—This lengthy paper is divided into the following sections :—Carbodiglucolic acid ether; carbo-glycolic acid ether.

White Cinchona Bark from Payta.—O. Hesse.—The author found that this bark contains, beside paytin, so large a quantity of starch that the bark might be used as a fermentable and distillable alcohol-producing material. The paytin is a new alkaloid, readily soluble in alcohol, ether, benzine, and chloroform; difficultly soluble in water, in potassa solution, and ammonia; it fuses at 156°, combines with acids, forming salts and double salts. The formula of paytin is $C_{21}H_{24}N_2O$.

On Mono-Bromotoluol; and on the Derivation of Isomeric Amido Bases from a Hydrocarbon.—H. Hubner and O. Wallach.—This paper contains the following divisions :—Crystallised bromotoluol, C_7H_7Br; bromo-nitrotoluol, $C_6H_3(NO_2)Br.CH_3$; monobromotoluidine, $C_6H_3Br.CH_3.NH_2$; toluidine; sulphate of toluidine; acettoluidine, $C_6H_4.CH_3(NH.C_2H_3O)$.

Some Derivatives of Naphthaline which belong to the Chinons.—C. Græbe and E. Ludwig.—This lengthy treatise is divided into the following chapters :—Biamido-naphthol—

$$C_{10}H_6(OH)\begin{cases}NH_2\\NH_2\end{cases}$$

biimido-naphthol—

$$C_{10}H_6(OH)\begin{cases}HN\\HN\end{cases}>$$

oximido-naphthol—

$$C_{10}H_6(OH)\begin{cases}HN\\O\end{cases}>$$

amido-oxynaphthol—

$$C_{10}H_6(OH)\begin{cases}NH_2\\OH.\end{cases}$$

oxynaphtho-chinon (naphthalinic acid)—

$$C_{10}H_6(OH)\begin{cases}O\\O\end{cases}>$$

trioxynaphthalin (bioxynaphthol)—

$$C_{10}H_5(OH)\begin{cases}OH\\OH\end{cases}$$

Diamido-Benzoic Acid.—P. Griess.

Constitution of Amygdalin and Amygdalinic Acid.—H. Schiff.

Isomeric Cresols.—L. Barth.

Direct Conversion of the Butyl-Iodide of Fermentation into the Amin-Basis of Trimethyl-Carbinol; and on the Conversion of the Butylamine of Fermentation into Trimethyl-Carbinol.—E. Linnemann.

Polytechnisches Journal von Dingler, second number for June, 1870.

The first number for this month has not come to hand; it will be quoted hereafter. This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Improved Hair Hygrometer.—MM. Hermann and Pfister.—The description, accompanied by engravings, of an instrument to determine the moisture of the atmosphere.

Estimation of the Pyrometric Value of Siliceous Substances.—Dr. C. Bischof.—This paper contains a discussion on the quantity of fluxes which render such substances—as, for instance, fire clay, and mixture of quartz-sand and alumina—fusible to such a degree as will prevent their application to blast-furnaces, puddling-ovens, and the like contrivances. The author tests the materials (native clays, sandstones, &c.) by reducing these substances to an impalpable powder, and mixing therewith from one to twenty times their weight of pure pulverised quartz. These mixtures are kneaded, with water, to a stiff paste, and pressed in prismatic shape, and, after air-drying, exposed to the same degree of heat—a temperature higher than the melting-point of wrought-iron.

Amorphous Silica as a means of Fixing Pigments and Dyes.—Dr. M. Reimann.—The author describes, at some length, a series of experiments made with the view to apply amorphous silica (as obtained by precipitating a solution of so-called water-glass, silicate of soda, or potassa, with an acid, and collecting, washing, and drying the precipitate in the ordinary way) for absorbing the solutions of fuchsine, aniline blue, &c., and to apply the coloured powder so prepared as a pigment for various materials. The author states that glass, first superficially acted upon by hydrofluoric acid, and next mordanted, as is usual for cotton, assumes, when submitted to the processes in use for dyeing fibre, precisely similar colours as that fibre, and that this effect is caused by the amorphous silica contained in the glass and made active by the hydrofluoric acid.

Preparation of Anthracen.—Dr. J. Gessert.—That portion of the distillation of coal-tar commonly called green grease, and used as waggon- and cart-grease, is, according to the author, the material of coal-tar which contains anthracen, and consists chiefly of a heavy oil, naphthaline, and about 20 per cent of anthracen, which, however, is only contained in coal-tar to an amount of from ½ to 1 per cent. This semi-fluid grease is first placed in a centrifugal machine, in order to expel, mechanically, as much as possible of the oil; the residue is heated to 40°, and pressed, preferably between hot plates. The cake thus obtained (crude anthracen, containing 60 per cent of that substance) is purified by boiling with light tar-oil (coal-tar naphtha), or with petroleum naphtha. The pasty mass is again placed in the centrifugal machine, to remove the last traces of heavy oil, and the material next submitted to sublimation. In order to test the green grease for the quantity of anthracen from 5 to 10 grms. of that substance are taken, placed between folds of filtering-paper, and pressed between hot plates; the remainder of the substance is repeatedly boiled with alcohol, washed with cold alcohol upon a filter, and next dried and weighed. The fusion-point of the mass should be, as near as possible, 210°. The author says that sulphide of carbon is not well suited for the purification of anthracen, because that substance is too readily soluble in that fluid. 100 parts of alcohol dissolve, when cold, 0·6 parts of anthracen; 100 parts of cold benzol dissolve 0·9 parts of anthracen; and 100 parts of sulphide of carbon dissolve 1·7 parts of anthracen.

Paper, and the Raw Materials it is made of.—Dr. H. Grothe.—This paper is a lengthy memoir and review on the treatise written on this subject by M. Z. Orioli, to whom has been awarded the prize of the Société Industrielle de Mulhouse, which Society has published the treatise alluded to.

New Method for the Preparation of Woody Substances into Pulp suitable for Making Paper.—O. Krieg.—Chiefly a review of what has been done in the United Kingdom as regards making paper from straw, esparto grass, wood, and other materials.

Detection of Sulphate of Soda in Carbonate of Soda.—Dr Hager.—The author states that it has become customary (at least in Germany) to mix, for the retail trade, crystallised sulphate of soda with the ordinary crystallised carbonate. In order to detect this fraud, the author advises to select a few crystals, or small lumps; place these in a basin, or suitable capsule, so that the lumps are about ½ centim. apart, and then to pour on them a solution of from 1 to 2 parts of corrosive sublimate in 100 parts of 80 per cent alcohol. The crystals of carbonate of soda will become coloured reddish brown by this reagent, while the sulphate of soda remains colourless.

Quantity of Carbonic Acid contained in the Air of School-Rooms.—Dr. Breiting.—The author made a series of fourteen experiments, beginning at 7.45 a.m. and continued to 4 p.m., in a room of 251·61 cubic metres' capacity and containing sixty-four children. The quantity of carbonic acid contained in the air of that room during these experiments varied from 2·21 to 9·36 per cent, while free open air contains 4-10,000th of that gas; and a quantity of 1 per cent of the same gas present in air is considered injurious to health.

Moniteur Scientifique, No. 327, August 1, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

New Method of Treating Native Sulphurets, Antimoniurets, Arseniurets of Copper, Lead, Nickel, Silver, and Iron.—Dr. E. Kopp.—The author first alludes to the mineral resources of Italy, which appear to be far greater and of more value than is generally known or suspected. The difficulty of rendering these treasures industrially available is the great scarcity of fuel. Under these conditions, a series of experiments have been made, to ascertain whether it might be possible to apply cheap and readily-accessible chemical reagents, so to act upon the above-named minerals (without simultaneously affecting the gangue) as thereby to render them in a state fit for being readily converted into metals. As reagents available for the purposes alluded to, the author has found common salt, chloride of iron, and hydrochloric acid readily to suit the requirements. Among the practical suggestions found in this paper, is the fact, that the most economical method to extract the small quantity of copper present in previously-burnt pyrites, consists in first exposing the burnt substance for a time to air and moisture, and then to pour over the material a solution of common salt. A small addition of hydrochloric acid is very useful; the copper thus becomes converted into a soluble chloride.

Preparation of Chromic Chloride.—F. Serena.—Instead of preparing this substance by the method described in books on chemistry, the author makes chlorine gas, previous to coming into contact with pure red-hot oxide of chromium, pass through chloroform or sulphide of carbon. By the use of the last-named substance, the reaction is accomplished according to the following formula—

$$Cr_2O_3+3CS_2+Cl_3=C_2Cl_6+3CO+S_6.$$

Towards the end of the operation, it is best to withdraw the flask containing the sulphide of carbon, and to continue the current of chlorine gas strongly.

Utilisation of Nitrate of Soda in the Metallurgy of Nickel and Soda.—R. Wagner.—The author describes, at great length, the method of operations of applying nitrate of soda to the purification of a secondary metallurgical product, a matter consisting, in 100 parts, of—Nickel, 25·22; copper, 37·65; iron, 10·58; sulphur, 26·45. This matte was first fused with the salt just named, and next re-melted with a mixture of 15 per cent of its weight of equal parts of nitrate and carbonate of soda, with the result that a metallic alloy was obtained consisting, in 100 parts, of—Nickel, 40·93; copper, 58·64; iron, 0·25; sulphur, 0·18. The lixiviation of the scoriæ yielded crystallised sulphate of soda. An arseniuret of nickel, containing, in 100 parts—Nickel, 48·20; cobalt, 1·63; bismuth, 2·44; iron, 0·65; copper, 1·93; arsenic, 42·08; sulphur, 3·07. By fusing this mineral with a mixture of 5 per cent of nitrate of soda and 10 per cent of anhydrous carbonate of soda, the author found that almost all the arsenic was eliminated as arseniate, and was mixed with the other impurities in the scoriæ. The regulus obtained consisted, in 100 parts, of—Nickel, 90·67; copper, 4·05; cobalt, 0·30; arsenic, 0·62; loss, 0·36.

On Vinage.—(The continuation of the paper quoted, with names of authors, in CHEMICAL NEWS, vol. xxii., p. 60.)—This portion of this very lengthy memoir is divided into the following sections:—The origin of the alcohols employed for the vinage; the object, or aim, of vinage, and the proportion of alcohol added to wine; the advantage and disadvantage of vinage; the modification vinage brings on in the composition of wine; and the answer to the question whether vinage is a fraud which ought to be prohibited, and, if so, by what means is it possible to improve wines and make them fit to be kept without altering their natural goodness or changing their composition.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 11, 1870.

This number contains the following original memoirs and papers:—

Molecular Volume of Chinon.—Dr. A. W. Hofmann.—The author has experimented on the vapour density of chinon, and has found the following results:—

	Theory. $C_{12}H_8O_4$.	$C_6H_4O_2$.
Weight of gas volume in reference to hydrogen	108·0 ..	54·00
" " " " air	7·5 ..	3·75

The author states that chinon is undoubtedly a monobenzol derivative.

Methyl-Aldehyd.—Dr. A. W. Hofmann.—The contents of this lengthy paper, full of formulæ, bear chiefly upon the determination of the vapour density of the solid methyl-aldehyd, by means of some peculiar compounds of the last-named substance with sulphur. There is added to this memoir the following PS.:—

Contribution to our Knowledge on the Sulphaldehyd of the Ethyl Series.

Some Observations on the Camphor Group.—W. Schlebusch.—This memoir is divided into the following chapters:—Action of alkalies on camphoric acid anhydride; on a nitrited derivative of camphor; on a derivative of camphor containing sulphur.

Constitution of Silicic and Hydrofluoric Acids in Aqueous Solutions.—J. Thomsen.—The author has experimented thermically

on the phenomena of neutralisation and basicity of the acids above-named, and states—The formula of silica in aqueous solution is that ordinarily accepted, $Si(OH)_4$; hydrofluoric acid, in aqueous solution, behaves towards silicic acid as a monobasic biatomic acid, having as formula—$H.Fl_3H$; the normal compound, the product of the reaction of silicic and hydrofluoric acids upon each other is—$Si(Fl_3H)_4$.

New Method of Preparation of Organic Chlor-Bromine Compounds.—L. Henry.—The author describes some experiments to prove the possibility of using chlor-iodethylen and chlor-iodhydrine for the purpose of obtaining the organic compounds above-mentioned, but an excess of bromine is necessary for the full reaction.

On Tribromhydrine.—L. Henry.—This paper is chiefly a reply to M. Berthelot, who had criticised the author's experiments and researches on this subject.

Contribution to our Knowledge of Crotonic Acids.—A. Kekulé.—This lengthy memoir is chiefly a critical review of the labours of a large number of scientific chemists on this subject, and contains such of the author's researches as may serve to bring about harmony and clear away doubts existing on this subject. The memoir is accompanied by diagrams and a large number of quotations from various scientific periodicals.

Curcumine, the Pigment of Turmeric Root.—F. W. Daube.—The author begins by stating that the substance hitherto known as curcumine, and usually obtained from the drug known as turmeric, by means of exhausting it with alcohol, is not pure curcumine, but a mixture of that body and various resinous matters. The preparation of curcumine is described as follows:—The previously coarsely-pulverised drug is submitted to a process of steaming, in order to remove the essential oil. The residue is next washed with boiling-water as long as that fluid becomes coloured; the material is then thoroughly dried, and next exhausted with boiling benzol (this fluid is only a very indifferent solvent for curcumine, since 1 part of the latter requires 2000 of the former for solution; but the use of benzol is, after all, indispensable, since it is the only fluid which leaves the resinous matter of the drug undissolved). On cooling, the hot benzol deposits crude curcumine, which is further purified, first, by being pressed between folds of blotting-paper, and next being dissolved in alcohol. The alcoholic solution is filtered, in order to separate a small quantity of a yellow-coloured flocculent matter. The filtrate is next precipitated with an alcoholic solution of acetate of lead. The ensuing precipitate is collected on a filter, washed with alcohol, next diffused through water, decomposed by sulphuretted hydrogen, and the mixed sulphide of lead and curcumine collected on a filter, washed, dried, and next exhausted with alcohol, which dissolves the curcumine. This solution being left to spontaneous evaporation, leaves curcumine in crystalline state, as a body, readily soluble in alcohol and ether, also in alkalies; the solution, in that case, exhibiting a bright red-brown colouration. Curcumine is insoluble in water; concentrated mineral acids (sulphuric and hydrochloric) dissolve it, but also alter it; it combines with lime and baryta, forming insoluble red-brown coloured compounds; its combination with metals are all insoluble in water; the lead compound is of a brick-red colour. Curcumine fuses at 165°, does not sublime, but is decomposed when further heated. The formula of curcumine is $C_{10}H_{10}O_3$, and that of its lead compound $C_{10}H_{18}PbO_6$.

Derivatives from Albumen Compounds.—W. Knopp.—This paper contains an as yet imperfect and preliminary notice on the action of sulpho-vinic acid upon albumen.

Derivatives of Hexyl-Hydride (Hexylwasserstoff, C_6H_{14}).—C. Schorlemmer.

Peculiar Formation of Cetyl-Alcohol.—C. Schorlemmer.—When a mixture of sebac acid and caustic baryta are submitted to dry distillation, there is formed, beside other products, a solid body, which, after having been purified, and re-crystallised by means of alcohol, yielded, by elementary organic analysis, results leading to the formula $C_{16}H_{34}O$. The substance in question fuses at 49°, and possesses all the properties of cetyl-alcohol.

On Curcumine.—Iwanof-Gajewsky.—This author, who has been investigating this subject simultaneously with, and independently of, the author of a paper on this subject alluded to above, states that sulphide of carbon takes up, from turmeric, an oil containing, beside oxygen, 80·2 per cent of carbon and 10 per cent of hydrogen. This oil boils at from 240°—260°. The drug having been next treated with ether, yields, to that solvent, curcumine, as yellow-coloured crystalline body, C_4H_4O, fusing at 172°; the drug contains, moreover, another pigment and an alkaloid.

Zeitschrift für Chemie von Beilstein, No. 12, 1870.

This number contains the following papers and memoirs:—

Substance Present in Bran which Yields Furfurol.—M. Gudkow.—The chief results of the author's researches are:—Furfurol is formed by a peculiar material present in bran to an amount of from 15 to 20 per cent, and chiefly contained in the husks of the grain, to which it imparts its elasticity. This furfurol-producing matter is insoluble in water, but soluble in very dilute sulphuric acid and in caustic potassa. When boiled with very dilute sulphuric acid, this substance is converted into a peculiar saccharine matter, which, on being treated with stronger sulphuric acid, yields, by distillation, furfurol. When cattle are fed with bran, the material which yields furfurol passes into their fæces. The author quotes a series of results of analysis of bran made by various chemists and at different periods of time; the quantity of woody fibre, recorded in these analyses as present in bran, varies from 4·1 to 34·6 per cent, while the quantity of starch and gum is put down at figures varying from 21·7 to 61·5. From these discrepancies, coupled with the fact that none of the analysts mention the material which yields furfurol, the author concludes that a portion of the quantities recorded as woody fibre, and a portion of that recorded as starch, ought to be quoted as furfurol-producing matter—a substance which does not simply occur in bran, but also in oil-cake, madder-root, and other plants.

Four Isomeric Ethyl-Naphthol-Sulpho Acids.—B. Maikopar.—The author describes briefly:—α ethyl-naphthol-sulpho acid,

$$C_{10}H_6(HSO_3)(C_2H_5)O,$$

and its baryta and potassa salt, the former fusing at about 57° and becoming thereby decomposed; the β acid, and the salts it forms with the same bases; and also the γ and δ acids, with some of their salts.

Bromonitro- and Bromamido-Benzol, and on the Position the Hydrogen of Benzol Occupies.—H. Hubner and M. Alsberg.—The authors say that they undertook these researches chiefly with the view of ascertaining whether the position of the 6 atoms of hydrogen contained in benzol is the same. For this purpose they have studied the bromonitrobenzols, of which they describe an α and β compound, the formula of the former being α $C_6H_4BrNO_2$; further, α and β bromamidobenzol, the former a solid substance, crystalline, fusing at 64·5°; the latter, formula β $C_6H_4BrNH_2$, a fluid which, when submitted to the influence of great cold, becomes solid, and, once solidified, remains solid, even up to 31°. The authors also describe, somewhat categorically, a series of salts, and, as regards the position of the hydrogen atoms of benzol, they come to the conclusion that the position and quantivalence of these atoms is the same for each of them.

On Agoniada and Agonidine.—Dr. P. Peckolt.—The author has extracted from the agonia bark *(Plumeria lancifolia)*, a tree indigenous to the Brazils, the bark being largely used in that country as febrifuge, a substance which he calls agonidine, a crystalline matter, devoid of smell, of a very bitter taste, difficultly soluble in ether but more readily so in boiling alcohol and boiling water, does not sublime on being heated, is soluble, also, in solution of caustic potassa; in ammonia and in concentrated sulphuric acid, the latter solution is at first of a golden-yellow colour, but turns gradually green. Upon the addition of nitric acid to the sulphuric acid solution of agonidine, a yellow-coloured flocculent matter is separated; this substance is a glucoside identical with arbutine, and contains no nitrogen. The formula of agonidine is $C_{10}H_{11}O_6$.

NOTES AND QUERIES.

Condensing Hydrochloric Acid Gas.—What time, and space of condenser, is required to condense the HCl gas produced from 896 lbs. ordinary common salt?—SALT.

Waterproofing.—"M. A. S." is referred to Ure's "Dictionary of Arts, &c.," vol. iii., and to Cooley's "Cyclopœdia of Practical Receipts." Both works may be inspected at the Library of the Commisioners of Patents.

Estimation of Alkalies in Silicates.—Can any of your readers inform me where to find Dr. Lawrence Smith's recent method of estimating the alkalies in silicates? I would suggest that a description of this process will be of value to a great many of your readers.—ANALYST.

Carbolic Acid.—(Reply to "Fitzetienne.").—Since the boiling-point of carbolic (phenic) acid is 188°, it is clear that it will be found in the products distilled over betwen 150° and 200°. The oily liquid, distilling over at that temperature, should be well mixed with a solution of caustic soda, which combines with the carbolic acid, forming a compound which may be readily decomposed by any strong mineral acid. To be brief, the process comes to a preparation of carbolic acid, carried on so carefully as to render it suitable for ascertaining quantities. For full particulars you are referred to Schützenberger, "Traité des Matières Colorantes," vol ii., pp. 4, 5.

Brewing Queries.—Can any of your readers supply me with either references or directions for brewing household beer—say 20 gallons at a time. I can manage the malt extremely well; but on each occasion when I have tried sugar, it never fines, or requires several months, and in either case has a sickly taste. The last may, perhaps, arise from using loaf sugar. I may add that I have tried the directions given by Donovan, in his "Domestic Economy," and also by boiling the sugar and hops, and fermenting in the usual way, "setting on" at about 25°—70°. (1) What are the relative values of malt and sugar? I have been accustomed to boiling down to 25° for the malt, and in sugar-beers calculating the sugar same strength. (2) How can I overcome the disposition of the sugar-beer holding in suspension the albumen, and get it clear and bright in a few days?—T. GREGSON.

Analysis of German Silver.—A good method of separating copper, nickel, and zinc, is to dissolve the alloy in hydrochloric acid containing a few drops of nitric acid, and precipitate the copper from the slightly acid solution in the form of sub-sulphocyanide of copper. The liquid, after being filtered and reduced, by evaporation, to a small bulk, is treated by excess of caustic potash, and then by hydrocyanic acid, until the precipitate which is at first formed is completely re-dissolved with a yellow colour. In this liquid, which contains the double cyanides, the zinc is precipitated in the state of sulphide, by means of protosulphide of potassium (not sulphide of ammonium). After some hours' digestion, and when the precipitate is completely deposited, it is filtered off, and, after boiling the liquid with *aqua regia*, the nickel is precipitated as oxide by caustic potash. This oxide must be calcined after it is dried.—F. WÖHLER.

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ON THE

ALKALINITY OF CARBONATE OF LIME.

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

CARBONATE of lime is described in chemical works as neutral to test-paper, but this scarcely agreeing with the results of observations I have had to make upon this point in the course of other investigations, I beg to give these results, which are as follows,—

1. Carbonate of lime, prepared by igniting pure oxalate of lime in a close crucible, at a dull red-heat, gives an intense alkaline reaction with reddened litmus-paper, after moistening with distilled water, or after re-ignition with pure carbonate of ammonia.

2. Carbonate of lime, prepared directly from chloride of calcium and bicarbonate of soda, by admixture of their aqueous solutions, and washing the ensuing precipitate till all the soda was removed, gave the same reaction with test-paper.

3. Limestone, shells (calcareous), calc-spar crystals, and arragonite, are all strongly alkaline to test-paper (at least, the samples I have tried were), the powder of any of these substances, washed with distilled water for many days, does not seem to lose any of this alkalinity.

Lastly (and, I think, conclusively), precipitated carbonate of lime, prepared by either of the above processes, when agitated with weak hydrochloric acid, in successive quantities, until gradually reduced to a minute proportion of its original bulk, still manifests this reaction to an eminent degree; indeed, the solution could not be rendered permanently acid till the whole of the carbonate was dissolved.

It seems impossible, under these circumstances, to attribute this reaction to the accidental presence of free magnesia or lime, sub-carbonate of lime, or alkaline carbonates, in the precipitate; this reaction may therefore, I think, fairly be attributed to the carbonate of lime.

NOTE ON

SOME NEW DERIVATIVES OF COUMARIN.

By W. H. PERKIN, F.R.S.

IN a paper read at the Chemical Society in May last,* I described some new bromine derivatives of coumarin, viz.,—

Dibromide of coumarin	$C_9H_6O_2,Br_2$
Bromo-coumarin	$C_9H_5BrO_2$
Dibromo-coumarin	$C_9H_4Br_2O_2$

and stated that the two latter compounds, when treated with potassic hydrate, yielded the salts of new acids. At that time I thought it possible that these products might be derivatives of coumaric acid. A more extended study of this subject, however, has shown that this is not the case.

When dibromo-coumarin is boiled with aqueous potassic hydrate it rapidly dissolves; the resulting solution, however, becomes, in a short time, a magma of crystals. These consist of the potassium salt of a new acid. Potassic bromide is also formed in large quantities. The reaction may be expressed thus:—

$$\underbrace{C_9H_4Br_2O_2}_{\text{Dibromo-coumarin.}} + 2KHO = \underbrace{C_9H_4KBrO_3}_{\text{Potassium salt of new acid.}} + KBr + H_2O.$$

* CHEMICAL NEWS, vol. xxi., p. 247.

The acid obtained from this potassium salt is crystalline, and possesses a very bitter taste; its formula is—

$$C_9H_5BrO_3.$$

Bromo-coumarin behaves in a similar manner when heated with potassic hydrate, producing a crystalline salt and potassic bromide. The acid obtained from this has not yet been analysed. It probably possesses the formula

$$C_9H_6O_3.$$

In the preparation of coumarin from hydride of salicyl it will be remembered that the hydride of sodium salicyl is heated with acetic anhydride; by modifying this process, and employing the sodium derivative of *bromo-salicyl* in place of that of salicyl, I have obtained a new bromo-coumarin differing entirely from that produced by the action of bromine on coumarin. It fuses nearly 50° C. higher, and although soluble in boiling potassic hydrate, is not decomposed by this alkali under ordinary circumstances. We have now, therefore, two monobromo-coumarins.*

Coumarin, when treated with fuming sulphuric acid, dissolves, forming a sulpho-acid, having the formula—

$$\left.\begin{matrix} C_9H_6O_2 \\ H \end{matrix}\right\} SO_3.$$

The acid crystallises in brilliant octahedra, which, when removed from their mother-liquor, rapidly become opaque. It forms a beautiful barium salt containing—

$$\left.\begin{matrix} C_9H_5O_2 \\ Ba'' \\ C_9H_5O_2 \end{matrix}\right\} \begin{matrix} SO_3 \\ {}_5H_2O. \\ SO_3 \end{matrix}$$

When heated strongly with sulphuric acid coumarin gives a disulphoacid, $C_9H_6O_{22}SO_3$.

None of the derivatives of coumarin I have examined appear to have any tendency to unite with water and form derivatives of coumaric acid.

ON THE

COMBINATIONS OF CARBONIC ANHYDRIDE WITH AMMONIA AND WATER.†

By EDWARD DIVERS, M.D., F.C.S.

(Concluded from p. 75.)

AMMONIUM-CARBAMATE heated to 59° or 60° furnishes vapour of the full tension, but it also volatilises at ordinary temperatures. It has a four-volume vapour, and this is the case even at ordinary temperatures, according to Bineau. It is, therefore, decomposed in volatilising into carbonic anhydride and ammonia. Further evidence of this is afforded by the fact that the vapour of carbamate may cool down to a much lower point than that at which it is formed before it condenses.

Rose has pointed out the following reactions of the carbamate as distinguishing it from the carbonates of ammonium:—It is not perceptibly affected by dry hydrochloric acid in the cold, and, warmed in the acid, is decomposed without liberation of water; in dry chlorine it is not affected at first, but is slowly decomposed without liberation of water; it assumes in the cold a pale yellowish colour when placed in sulphurous anhydride; it does not form water when heated in sulphuretted hydrogen, and it yields carbonic anhydride *without effervescence* when the vapours of sulphuric anhydride are passed over it. Besides these, it has a special reaction in solution with calcium chloride; when mixed with anhydrous calcium chloride, it can be expelled by a gentle heat, leaving the chloride

* Dr. H. Büsecke by employing the sodium derivative of the hydride of chlorosalicyl in a similar manner has obtained a chlor-coumarin possessing properties analogous to those of this new bromo-coumarin.—*Ann. d. Chem. u. Pharm.*, April, 1870.

† Abstract, by the Author, of a paper communicated to the Chemical Society.

unchanged; it does not melt or become moist when heated; and it dissolves freely in strong ammonia water.

The constitution of the carbamate is almost certainly that indicated by its name, and represented by the formula—$CO_2(NH_2)(NH_4)$. But no metallic carbamates have as yet been obtained. However, by mixing a very concentrated ammoniacal solution of ammonium carbamate with a saturated solution of calcium chloride, a precipitate may be obtained which is soluble in water, though the solution almost immediately deposits chalk. This precipitate proves, on analysis, to be either calcium carbamate or a double carbonate of calcium and ammonium; which of the two cannot be decided because of the presence of water and other impurities. Ammonium carbamate may be represented as an orthocarbamic acid, thus—

$$CO_2(NH_2)_2H_2 \text{ or } C(NH_2)_2(OH)_2,$$

but there is no evidence as yet to support this view of its constitution, unless it be that afforded by the fact that ammonia prevents the passage of the carbamate into carbonate, which may be supposed to be due to the union of the ammonia with this acid to form an orthocarbamate slightly more stable, acccording to this equation—

$$C(NH_2)_2(OH)_2 + 2NH_3 = C(NH_2)_2(ONH_4)_2.$$

The "Carbonate of Ammonia" of Commerce.

In the main, the published analyses of this substance show that the samples examined had about the composition expressed by the formula—

$$(CO_2)_3(OH_2)_2(NH_3)_4.$$

Samples of the carbonate at present in commerce, obtained from various sources, have proved to be of very uniform composition (with one special exception); this, however, is not expressed by the above formula, but by the simpler one—

$$(CO_2)_2OH_2(NH_3)_3.$$

The percentage numbers obtained agree closely with the calculated numbers, except that they indicate the presence of 1 or 2 per cent additional water and a slight excess of ammonia, but to an extent quite immaterial so far as the determination of the atomic composition is concerned.

Several proofs, other than analytical, can be adduced to show that the carbonate now in commerce differs from that most generally in commerce formerly. One is that, as has been already mentioned, ammonium carbamate condenses out of the products obtained by distilling together the carbonate and anhydrous calcium chloride. The following equations show that this can only take place when, of the two carbonates, that now in commerce is employed:—

$$2(CO_2)_2OH_2(NH_3)_3 + 2CaCl_2 = \\ = 4NH_4Cl + 2CO_3Ca + \underbrace{CO_2 + 2NH_3}_{\text{To form carbamate.}}.$$

$$(CO_2)_3(OH_2)_2(NH_3)_4 + 2CaCl_2 = \\ = 4NH_4Cl + 2CO_3Ca + CO_2.$$

The single exception observed to the uniformity in composition of the commercial carbonate was the occurrence of a layer of *acid carbonate* adhering to a layer of the usual carbonate. It was crystalline, almost devoid of ammoniacal taste and smell, and was permanent on exposure. An instance of the occurrence of the acid carbonate in commerce was noticed by Phillips fifty years ago. It has already been mentioned that the acid carbonate can readily be obtained in this form by the slow distillation of its ordinary form.

The ordinary commercial carbonate, exposed to the air, loses a proportion of its weight, corresponding to that calculated from the formula now found for it, on the assumption that the carbamate in it volatilises and the acid carbonate remains. It dissolves in 4 parts of water at 15°, so that it and the half-acid carbonate both possess solubilities which seem to directly depend upon the amount of acid carbonate they each contain. A warm saturated solution cooled, deposits crystals of acid carbonate; the mother-liquor warmed with fresh commercial salt again deposits acid carbonate, and the same thing will occur several times on repeating these operations; at length, the mother-liquor, warmed with fresh commercial carbonate, deposits crystals of the half-acid carbonate, and the same thing also occurs several times on repeating the operations; then the mother-liquor from one of these crops, which is a very concentrated solution and contains to one atom of carbonic anhydride more than two of ammonia, deposits gradually a considerable quantity of large crystals of the normal carbonate; lastly, if, instead of waiting for these crystals to form, the normal carbonate is precipitated by passing a current of ammonia gas through the mother-liquor kept cold, the salt remaining in solution appears by its reaction with calcium chloride to be—at least, a large proportion of it—the ammonium carbamate.

The commercial carbonate heated with anhydrous potassium carbonate evolves large quantities of ammonia at a temperature of 50°—60°; when this evolution has nearly or entirely ceased, and the heat is carried to 65°, carbonic anhydride and ammonia escape in the proportion in which they form carbamate, and acid potassium carbonate remains behind. Two reactions, therefore, occur; firstly, a combination of carbamate with acid potassium carbonate is formed, and then this is decomposed, thus:—

$$\text{(1st).} \quad (CO_2)_2OH_2(NH_3)_3 + CO_3K_2 = \\ = NH_3 + CO_2(NH_3)_2,CO_3KH + CO_3KH.$$

$$\text{(2nd).} \quad CO_2(NH_3)_2,CO_3KH = \\ = \underbrace{CO_2 + 2NH_3}_{\text{To form carbamate.}} + CO_3KH.$$

When calcium chloride is used instead of potassium carbonate, the carbamate-forming gases come off below 65°, and this fact, besides that of the volatility of the uncombined carbamate, affords further proof that, when potassium carbonate is used, the carbamate is held in chemical combination with acid potassium carbonate. When the solid hydrated calcium chloride of commerce, which contains about two atoms of water to one of the chloride, is mixed in powder with the commercial carbonate, the mixture has no smell, soon grows warm, swells up, evolves large volumes of carbonic anhydride, and, after gentle heating, consists of chalk and ammonium chloride, together with any excess of either substance used. Regarded as a single substance, the commercial carbonate is best represented as a double salt of carbonic and carbamic acids with ammonium, thus:—

$$CO_3(NH_4)H,C(NH_2)O_2(NH_4).$$

Products of the Distillation of Sal-Ammoniac with Chalk, with Potassium Carbonate, and with Sodium Carbonate.

It is always stated that the products of the distillation of sal-ammoniac and chalk are the substance

$$(CO_2)_3(OH_2)_2(NH_3)_4,$$

water, and free ammonia; but this must be done upon theoretical grounds only. When these substances are distilled together, the vapours evolved entirely condense to water and a slightly hydrated carbamate. The formation of the commercial carbonate takes place during the refining process, which consists, as is well known, in re-distilling the products of the first distillation with a little additional water, at a temperature of about 65°. A mixture of sal-ammoniac with either anhydrous potassium or sodium carbonate also yields, when distilled, water and a slightly hydrated carbamate, but some ammonia escapes in the first stage of the operation. This arises from some of the undecomposed alkaline carbonate fixing carbonic anhydride and water, thus:—

$$CO_3K_2 + \underbrace{CO_2 + OH_2 + 2NH_3}_{} = 2CO_3KH + 2NH_3.$$

When pearl-ash is distilled with fully its equivalent of

sal-ammoniac and with aqueous alcohol, as in preparing *spiritus ammoniæ aromaticus* (Ph. Lond.) the distillate, as has long been known, is a solution of normal carbonate or equivalent in composition to it. But the first and more alcoholic portions, collected separately, soon deposit crystals of the half-acid carbonate, the mother-liquor being left basic or with more than two atoms of ammonia in it to one of carbonic anhydride. By following the directions of the British Pharmacopœia, and using the commercial carbonate of ammonia and water of ammonia in place of pearl-ash and sal-ammoniac, similar results are obtained.

Products of the Distillation of the Commercial Carbonate of Ammonia, of the three Ammonium Carbonates, and of the Ammonio-Magnesian Carbonate.

When the carbonate of ammonia of commerce is distilled, it is re-obtained as almost the sole product, unless the distillation is carried on exceedingly slowly. In this case some carbamate, mixed with only a little carbonate, is obtained, in the further end of the retort-neck, and also, near the termination of the process, a little of a more hydrated and carbonated product than the commercial carbonate, but the great bulk of the quasi-sublimate is still the commercial carbonate, $(CO_2)_2OH_2(NH_3)_3$.

Rose distilled the carbonate formerly in commerce very slowly, and found some of the remote part of the product to have a composition expressed by the formula

$$(CO_2)_2OH_2(NH_3)_4,$$

and the bulk of the product to have a composition which is that of the carbonate now in commerce with 5 per cent additional water, though he gave it a formula which would now be written

$$(CO_2)_5(OH_2)_4(NH_3)_8.$$

Products thus obtained are always moist when first formed, so that neither of these need be regarded as a single and definitely hydrated substance. Distilled with alcohol the commercial carbonate yields carbamate and water.

When the normal carbonate of ammonium is distilled very slowly the products are the carbamate and water, and when the acid carbonate is similarly distilled the product is the acid carbonate again; but when either the normal, the acid, or the half-acid carbonate is distilled more rapidly, partial condensation only of the products takes place, and in such a way that the carbonate of commerce is formed, according to the equations—

$$2[CO_2+2OH_2+2NH_3] = (CO_2)_2OH_2(NH_3)_3+3OH_2+NH_3.$$

$$3[CO_2+OH_2+NH_3] = (CO_2)_2OH_2(NH_3)_3+2OH_2+CO_2.$$

$$3[3CO_2+4OH_2+4NH_3] = 4[(CO_2)_2OH_2(NH_3)_3]+8OH_2+CO_2.$$

It has already been mentioned that the half-acid carbonate can be obtained by distilling the ammonio-magnesian carbonate. This, however, is probably a secondary product. The true products appear to be water, carbamate held in solution in the water and rapidly becoming hydrated, and, towards the end of the distillation, some acid carbonate.

The Single or Chemical Substances that are Formed by Condensing Mixtures of Carbonic Anhydride, Ammonia, and Water.

All compounds of carbonic anhydride with ammonia and water are decomposed into these substances when they are heated. The products of their distillation are, therefore, results of these substances combining together.

Ammonium carbamate is one of the single or chemical substances formed from a mixture of carbonic anhydride, ammonia, and water. The conditions for its formation appear to be the presence of the ammonia in the proportion of at least two atoms of ammonia to one of the carbonic anhydride and a little water in the liquid state.

Acid ammonium carbonate is another single substance formed from the above mixture. The condition for its formation appears to be the introduction of water-vapour and ammonia in atomic proportions into carbonic anhydride so slowly that the water is never in sufficient quantity to pass its point of maximum density at the temperature of the receiver, and therefore to condense to the liquid state.

Commercial carbonate, $(CO_2)_2OH_2(NH_3)_3$, is most probably a third, and the only other single substance formed from the above mixture. The grounds for considering it to be a single substance are—(1) that it is formed so unfailingly and readily by the distillation of any of the true ammonium carbonates; (2) that it can be distilled, and its products again readily condensed to a substance of the same composition; (3) that its composition, when prepared under varying conditions, is closely in accordance with the calculated numbers; (4) that its composition is relatively a very simple one; (5) that ammonium carbamate combines apparently with acid potassium carbonate; and (6) that no other products can be prepared by distillation of uniform composition but this substance, the carbamate, and the acid carbonate, and be re-distilled and condensed into products of the same composition again.

The conditions which seem to be necessary to the formation of the commercial carbonate are—(1) the cooling of a mixture of two volumes of carbonic anhydride and three volumes of ammonia in presence of at least the calculated quantity of water; or (2) the cooling of a mixture of more than two volumes of carbonic anhydride to three of ammonia in presence of at least enough water, provided that some of this is in the liquid state; or (3) the cooling of a mixture of less than two volumes of carbonic anhydride to three volumes of ammonia in presence of enough water in the state of vapour at the temperature at which they combine.

ON SUPERSATURATED SOLUTIONS.*

THE following paper by Mr. Grenfell appeared in *Nature* for the 4th of August, 1870:—

The following experiments may be found interesting from their bearing on the latest theories advanced on the subjects on supersaturation and the so-called inactive state of bodies. Professor Tomlinson's theory is that a supersaturated solution adheres as a whole to a chemically clean surface, but that a differential adhesion takes place in presence of a chemically unclean surface, because the salt or gas adheres to such a surface while the liquid does not; the former is consequently liberated. The presence or absence of grease is then stated to constitute chemical uncleanness or cleanness. If a greasy surface can be rendered inactive, it is clear that both these propositions cannot be true; either grease is not of itself a cause of uncleanness, or unclean surfaces are not necessarily active ones. The following experiments prove that the fats may be rendered inactive by the same processes which are applied to rods of glass or metal.

1. A bit of composite candle was melted with a very little alcohol; a glass rod was dipped in, allowed to cool, passed through flame of a Bunsen's burner, and a drop of melted fat deposited on surface of supersaturated solution of zincic sulphate. The fat solidified without affecting the solution even on prolonged agitation. A crystal of the salt caused instant solidification.

2. Same solution boiled remained supersaturated for a fortnight with a crust of fat on the top.

3. Ordinary tallow treated as No. 1. Inactive in solution of sodic sulphate solution; touched with finger, crystallised at once.

4. Lard cleaned simply by melting on rod passed through

* Communicated by C. Tomlinson, F.R.S.

flame, allowed to cool, stirred in solution of sodic sulphate. Inactive. Other end of rod active at once,

5. Same solution boiled; cooled, stirred with rod, treated as the last, and left exposed to the air for 15 minutes. Did not crystallise. This experiment is interesting, as showing that greasy substances are not specially liable to be made active by exposure to ordinary air.

6. Some tallow was melted in a test-tube without precautions of any kind, and while melted was poured to the depth of half an inch on to solutions of ferrous, cupric, and sodic sulphates. In each case it was inactive. This is conclusive on the point in question.

Theoretical objections have been urged against the definition of chemical uncleanness, and I think this might now be surrendered.

Professor Tomlinson may very likely be right in looking to adhesion for an explanation of these phenomena; at all events, far greater probability seems to attach to this view than to that put forth by M. Gernez, adopted by Jamin, and even, I believe, favourably noticed by the Academy itself; which is that only a crystal of the same salt can induce crystallisation. This latter view is open to the theoretical objection that it necessitates our believing that all salts capable of supersaturation are everywhere and at all times present in the atmosphere. Mr. Tomlinson has shown experimentally that a crystal of the salt properly treated can be inactive in a solution of sodic sulphate.*

The following experiments show that an atmosphere presumably saturated with the salt may be inactive without any precautions whatever:—

7. Three solutions of sodic sulphate were prepared; a glass rod was dipped in melted tallow and left to cool for five minutes in a bottle of the salt, without touching the salt or the sides of the bottle. Then the three solutions were successively touched with the rod; inactive in all. Rod replaced in the bottle for ten more minutes; then all three again touched. The third crystallised after a minute or two. Rod replaced for fifteen minutes; active only in the second; replaced for fifteen minutes, active in the last. Thus this greasy rod was inactive in one of the solutions after an exposure of thirty minutes, and after being six times dipped in solutions of the salt.

8. An open test-tube, containing a strong solution of sodic sulphate, remained supersaturated for a week suspended in the same large bottle of the salt. The bottle was frequently moved without producing any effect. On removing the cork, the solution crystallised instantly.

On the whole I am afraid we must for the present fall back upon that refuge for the destitute, "Catalytic action."

J. G. GRENFELL.

Birmingham.

The following is Mr. Tomlinson's reply to the above:—

During the last two years, I have made a large number of experiments, in order to ascertain the function of oils and fatty bodies in determining the crystallisation of supersaturated saline solutions. The results of my inquiry are included in a paper which was read before the Royal Society on the evening of the 16th of June last; and I beg to refer to the abstract thereof in the *Proceedings*.

I may, however, be permitted to make a few remarks arising out of Mr. Grenfell's paper.

According to my view, a *nucleus* is a body that has a stronger attraction for the gas, or the vapour, or the salt, of a supersaturated solution, than for the liquid that holds it in solution.

Nuclei, with certain limitations, cease to be such when made *chemically clean*.

A body is chemically clean the surface of which is entirely free from any substance foreign to its composition.

Thus, oils and fatty bodies are chemically clean if chemically pure and containing no substance mixed or dissolved that is foreign to their composition.

The limitations above referred to are two—(1) The oils, &c., when chemically clean, do not act as nuclei while in the mass, such as a lens or globule; but these oils, &c., whether clean or not, act powerfully as nuclei when in the form of thin films. (2) A liquid, at or near the boiling-point, is a supersaturated solution of its own vapour; and a *porous* body, such as charcoal, pumice, &c., whether clean or not, is a powerful nucleus in separating vapour.*

I have, on several occasions, taken the liberty of opposing M. Gernez's views, as to the action of nuclei. He supposes (1) that supersaturated gaseous solutions (soda-water, Seltzer, &c.) give off their gas to nuclei, by virtue of the air that these latter introduce into the solution; in other words, gas must escape into air, and the function of the nucleus is to carry down air: hence, rough bodies act better as nuclei than smooth ones. I have shown,† in a series of twelve experiments, that air is not a nucleus, and that rough bodies are inactive if *catharised* or made chemically clean. A rat's-tail file, for example, is a good nucleus, because it holds between its teeth that filmy kind of matter that is powerfully nuclear; and it is not easy to clean a body of this kind; but, when clean, it is quite inactive. So, a flint stone that has been exposed to the air, or handled, acts as a powerful nucleus; but, when broken, the newly-fractured surfaces are inactive, because chemically clean. And such surfaces are inactive because the gaseous solution adheres to them as a whole; whereas, if a clean body be handled, or exposed to the air, it becomes covered, more or less, with filmy matter, to which the gas adheres more strongly than the liquid, and hence there is a separation of gas.

There is, I think, abundant proof that air is not a nucleus; its function, if it have any, as regards the phenomena in question, being that of a carrier of nuclei. Proof, also, is wanting, I imagine, that, when a nucleus determines the crystallisation of a supersaturated saline solution, a salt of its own kind is present. When M. Gernez so laboriously prepared his nuclei, so as to free them from salt, he did not, perhaps, reflect that he was making them chemically clean. Of course, I fully admit that a salt of the same kind as the solution acts as a powerful nucleus; but, in order for it so to act, it must adhere more strongly to the saline than to the liquid portion of the solution. It may even happen that a crystal of the same kind, and of the fully hydrated salt, has no nuclear action, because it is in a perfectly catharised condition. And here I must refer to the objection raised by Dr. De Coppet, that, in one of my forms of showing the experiment, the hydrated crystals, say, of magnesic sulphate, being introduced into the neck of the flask while the solution was boiling, and so left in the covered flask while the solution cooled, such crystals became so changed by the heat as no longer to represent the normal salt; so that, when lowered into the solution, they formed a different salt, and, hence, were no test of the point in question, as to whether a salt of the same kind may be rendered inactive as a nucleus. I admit the criticism to be just, but, in my original account of the experiment,‡ I

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* It would seem from the experiments of Dr. L. C. de Coppet (which do not appear to be as well known as they deserve) that the treatment adopted by Mr. Tomlinson for rendering the sodic sulphate inactive really changes the salt. Dr. de Coppet finds that a supersaturated solution of sodic sulphate may be prepared by dissolving the anhydrous salt in cold water; and he writes—"I have arrived at the conclusion that the anhydrous sodic sulphate obtained by the efflorescence of the crystals with ten molecules of water, undergo a change of constitution when heated to temperatures superior to 33° or 34°; for the contact of a particle of the effloresced sulphate always causes the crystallisation of a supersaturated solution of this salt, whereas anhydrous sodic sulphate heated above 33° does not necessarily determine the crystallisation."—*Bull. Soc. Vaud. Sc. Nat.*, x., p. 151.

[These experiments render it probable that the so-called supersaturated solutions really contain the anhydrous salt in a state of unstable equilibrium, only requiring a disturbance to cause it to assimilate water, and thus produce a less soluble compound.—ED. *Nature*.]

* *Proc. Roy. Soc.*, No. 108, 1869.

† *Phil. Mag.*, Aug. and Sept., 1867. CHEMICAL NEWS, vol. xvi., pp. 54, 149.

‡ *Phil. Trans.*, 1868, p. 665. CHEMICAL NEWS, vol. xviii., p. 110.

did not rely upon one form. Highly-supersaturated solutions in clean tubes, plugged with cotton wool, were placed, when cold, over sulphuric acid, under the receiver of the air-pump, and left for some time *in vacuo*; when crystalline crusts of the normal salt formed on the surface, and these, by shaking, fell through the solutions without acting as nuclei; whereas, on removing the cotton wool in the presence of air, the solutions crystallised immediately into a solid mass. So, also, by keeping supersaturated solutions during some months, vapour of water escapes through the cotton wool, and a crystalline crust of the normal salt creeps up the air-filled portion of the tube; and this has no nuclear character, because the adhesion between it and the solution is perfect.

So necessary is the action of a nucleus in determining crystallisation in these solutions, that, if care be taken to exclude nuclei, highly-supersaturated saline solutions may, by reduction of temperature to 0° F., or from that to −10° F., be made solid; and, on placing the tubes in snow and water at 32°, the solids rapidly melt into clear bright solutions, without any separation of salt. These effects may be shown any number of times; but, whether the solution be solid or liquid, if the cotton wool be removed for a few seconds, crystallisation always sets in, in the case of the solid, during the melting; in that of the liquid, the effect is immediate.

With respect to the editorial note that the solutions of hydrated salts contain the anhydrous salt, I have shown, in my paper in the *Transactions*, and with still greater elaboration elsewhere*, that such is the case with respect to sodic sulphate. I insist on this point, as it is one of first-rate importance in considering the theory of supersaturated saline solutions. I endeavour to prove that it is the anhydrous salt in solution, by showing that, at various points of the scale, a sudden lowering of the temperature produces a shower of the well-known octahedral crystals of the anhydrous salt. I also explain, in my original memoir, that it is necessary for these crystals to be deposited before the modified seven-atom salt can be formed; and that, even when there is a copious deposit of this salt, the liquor above it is not, as Löwel supposed, the mother liquor of the seven-atom salt, but it is still a solution of the anhydrous salt. And, more than this, when the sudden change in the curve of solubility takes place at 33° or 34° C., and there is, according to Gay Lussac's supposition, a change in molecular condition, it is still the anhydrous salt that is in solution.

Charles Tomlinson.

Highgate, N., August 8th, 1870.

EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.†

By Frank H. Storer,
Professor in Massachusetts Institute of Technology.

Several teachers who have attended the free courses of instruction in General Chemistry and Qualitative Analysis, established at the Institute of Technology, through the liberality of the trustee of the Lowell Institute, have expressed a desire to prosecute the study of Quantitative Analysis also,—at least, far enough to obtain a general idea of the methods actually employed in that branch of chemical art.

The object of the following communication is to show how readily this desire may be gratified, even without access to a well-appointed laboratory.

In most manuals of Quantitative Analysis, and in most of the laboratories established for teaching students who are to pursue chemistry as a profession, the subject is treated of in such manner that a costly balance seems to be absolutely essential for the conduct of accurate operations. The would-be amateur is usually disheartened at the first glance by this requirement, and led to regard the study as something not only occult in itself, but impracticable for him, because expensive.

It must be remembered, however, that, though now indispensable to the professed chemist, the delicate "chemical balance" is, comparatively speaking, a thing of yesterday. The science has actuually been built up, for the most part, through the use of far rougher implements, such as may now be obtained almost anywhere for a few dollars. There is, in fact, no real difficulty in making thoroughly satisfactory analyses of a great variety of substances, by means of a cheap balance, if the operator will but work with tolerably large quantities of his materials.

The advantage in using a delicate balance consists chiefly in the time gained by operating upon small quantities. Other things being equal, a precipitate, which weighs only a few grains, may evidently be collected, filtered, and washed more readily than one weighing the same number of drachms.

The following analysis made under my direction, in the Institute's laboratory, by my assistant, Mr. A. H. Pearson, may serve as examples of what can readily be accomplished by a careful manipulator tolerably familiar with chemical principles. It may be remarked that several of these analyses are better than the average of analyses made with fine balances and small quantities.

The apparatus required for the following experiments consists of a couple of sheets of "Swedish," and five or six sheets of ordinary filter paper; two glass stirring rods; two glass funnels, each large enough to carry a six-inch filter; three or four glass beakers; a couple of glass flasks, one of them fitted with tubes as a wash-bottle; a crucible and an evaporating dish of Berlin porcelain; a Bunsen's gas-burner, or an alcohol lamp; and an iron ring stand, furnished with a rough sheet-iron saucer,—for use as a sand bath; a triangle of iron wire and a piece of wire-gauze four or five inches square. Instead of the ring stand, a tripod of stiff wire may be used. For experiment No. VI. a burette will be needed also.

The balance actually used in the experiments here recorded was an apothecary's "prescription scale," capable of carrying 60 grammes or more on each pan, and delicate enough to move distinctly with a weight of two milligrammes. It was made by Becker and Sons, of 18, Exchange Place, New York, and bought of their Boston agents, J. T. Brown and Co., corner of Washington and Bedford Streets, for 8.60 dollars in gold. The weights employed were a set of ordinary German gramme weights, worth five or six dollars.

With the exception of parts of Experiments VII. and VIII., all the operations described may be performed without trouble in any ordinary room. The evaporation of the acid liquor in Experiment VII. may be readily effected by placing the lamp, ring-stand, and evaporating dish in a not too tight wooden box out of doors.

Experiment I.—*Determination of Iron by Precipitation as Sesquioxide.*

Weigh out about 3 grammes of fine, tough iron-wire. Put the wire in a beaker of about a litre capacity, and pour upon it 30 or 40 c.c. of pure strong chlorhydric acid. Place the beaker on a sand-bath or piece of wire gauze above the lamp, cover it with a piece of window glass, and heat its contents gently, so that the iron may dissolve with tolerable rapidity, but without violent ebullition. When the iron has dissolved, add 10 or 12 c.c. of strong nitric acid to the solution and continue to heat the mixture. Through the oxidising power of nitric acid, the ferrous chloride will be changed to ferric chloride. Meanwhile, the liquid will become temporarily dark coloured by dissolving a quantity of the hyponitric acid, which results from the reduction of the nitric acid. But after a few moments the liquor becomes clear again, as the nitrous fumes escape, and then exhibits the characteristic

* Chemical News, vol. xx., p. 277.
† Communicated by the Author. From the *Massachusetts Teacher*.

reddish-brown colour of ferric chloride. As soon as the temporary dark colour has disappeared from the solution, lift the cover of the beaker, and by means of a wash-bottle rinse back into the iron solution any particles of liquid which may have been thrown up during the action of the acid and left adhering to the plate. Dilute the iron solution with pure water enough to nearly fill the beaker, stir the mixture with a glass rod, and transfer half of it to another beaker of the same size as the first. Heat the contents of each beaker almost to boiling, stir the liquor, and add to it, little by little, ammonia water, until the odour of the ammonia persists. A couple of filters of "Swedish paper," each of six inches diameter, will be sufficient to collect the whole of the hydrated sesquioxide of iron thus thrown down. To facilitate the process of filtering and washing, proceed as follows:—Let the contents of each beaker stand at rest for a few moments in order that the hydrate of iron may settle; then pour into the filter the tolerably clear liquid which floats above the precipitate, and pour a quantity of boiling water upon the precipitate in the beaker. As soon as the mixture of precipitate and water has settled again somewhat, pour the tolerably clear supernatant water into the filter and again pour hot water upon the precipitate in the beaker. Repeat this process of *washing by decantation*, some eight or ten times; then wash out the whole of the precipitate from the beaker into the filter, by means of a wash-bottle, and continue to pour hot water upon the contents of the filter, until the last traces of chloride of ammonium have been removed. When the last drops of wash-water have drained away, cover the funnels with paper to protect the precipitates from dust, and set them aside in a moderately warm place.

Transfer the dried precipitate from the filters to a porcelain crucible of known weight, burn the filters upon the cover of the crucible until the last portions of carbon are destroyed, add the ashes to the precipitate in the crucible, cover the latter, and heat it strongly for eight or ten minutes over a Bunsen lamp. In burning the filters, it is well, towards the close, to press down the unburned carbon against the hot porcelain by means of a stiff wire.

After the crucible has been allowed to become cold, weigh it with its contents. This weight, minus the original weight of the crucible and that of the filter ash (for which an allowance of 0·3 per cent of the weight of the paper may be made), will give the weight of the sesquioxide of iron, whence the weight of iron may be calculated by the following proportion :—

Wt. of a molecule of Fe_2O_3	:	Wt. of the 2 atoms of Fe therein contained	: :	Wt. of Fe_2O_3 found.	:	X.

Starting with 3 grammes of metallic iron, Mr. Pearson obtained 4·282 grms. of Fe_2O_3 (= 2·9974 grms. Fe), or in terms of per cents, 3 : 2·9974 = 100 : 99·91 per cent.

(To be continued).

ON GLAUKOPYRITE, A NEW MINERAL.

THE following abstract of a publication by F. Sandberger is taken from *Verhandlungen der K. K. Geologischen Reichsanstalt* :—

In pieces of coarsely-lamellar calc-spar, brought by Dr. Schierenberg from the mines of Guadalcanal, Andalusia, different ores were observed, the examination of which was undertaken by Professor Sandberger. This resulted in the proof of the existence of a new mineral, which occurred, together with solid, crystallised fahlore, proustite, and scattered bunches of Iamesonite, the new mineral greatly predominating in quantity. It appears in kidney-shaped aggregations, composed of extremely thin shells of finely-granular structure, which repeatedly alternate with thin layers of calc-spar, and rarely with those of proustite. The kidney-shaped masses are entirely surrounded with lamellar calc-spar; and, if this is removed with acetic or dilute muriatic acid, the surface appears to be formed by numerous, mostly very small, crystals, in comb-like aggregations. On the layer of these crystals, Sandberger could discern, with a magnifying glass, as a fundamental type, twins of two flat rhombic tables, lying crosswise to each other, and presenting the habitus of cerussite—twins of similar combination; besides these, triplets can be distinctly recognised. The streak of the fine granular masses is shining, but the lustre of the crystal faces is feeble, except certain faces, supposed to be normal prismatic and brachy diagonal prismatic, which have a strong metallic lustre. The colour of the mineral is light lead-grey to tin-white, the streak greyish black; hardness, 4·5; sp. gr., 7·181. In contact with the air, the mineral tarnishes slowly, first assuming a blackish, afterwards a yellowish brown, and finally a blue colour. An analysis made by R. Senfter, in the laboratory of Dr. Petersen, gave the following result:—

Sulphur	2·36
Arsenic	66·90
Antimony	3·59
Iron	21·38
Cobalt	4·67
Copper	1·14
	100·04

The new ore belongs, consequently, to the group of arsenical pyrites, and comes nearest to the mineral from Wolfach, which Sandberger identified with Briethaupt's geyerite.

But, as neither form nor hardness, nor specific gravity and colour, are the same in both, and as, moreover, the copper observed in the new mineral is wanting in geyerite, Sandberger proposes, for this new ore from Guadalcanal, the name *glaukopyrite*, and gives for its composition the formula—

$$FeS_2 + 12\left.\begin{matrix}Fe\\(Co)\\(Co)\end{matrix}\right\}\begin{matrix}As_2\\(Si_2)\end{matrix}$$

—*American Engineering and Mining Journal.*

NUCLEI AND SUPERSATURATED SALINE SOLUTIONS.

By ARCHIBALD LIVERSIDGE,
Associate of the Royal School of Mines.

I FORWARD the following account of some experiments made upon supersaturated solutions of sodic sulphate, (and attempted explanations of the action of nuclei upon the same, which have presented themselves to my mind from time to time), in the hope that they may not be entirely devoid of interest to some of your readers.

I may state in the outset, that the experiments were carried out in April, May, and June, 1869, since which date I have repeated and confirmed them all, in some cases, perhaps, a score or more times.

Mr. Tomlinson has already shown that air itself is not a nucleus, nor is a clean crystal of sodic sulphate; he has also shown that a "chemically unclean" rod, or other solid body, may be rendered clean by heating it in the flame of a spirit lamp, or by boiling it in the solution itself. He has also given us a definition of a nucleus:—"A nucleus is a body that has a stronger adhesion for the salt than for the water which holds the salt in solution, a state of things brought about by the absence of chemical purity" (see CHEMICAL NEWS, vol. xviii., p. 3); and in vol. xiv., p. 128, he says "this action of solid bodies is due to the greasy film which, after exposure to the air, they are sure to acquire."

My own views regarding the action of nuclei were just the reverse of that given in the above definition. I imagined that the nucleus was a body which had a greater attraction for the water of the solution than for the salt in solution, and I see no reason why this should not be so.

In order to prove, if possible, the correctness of this speculation regarding the nature of nuclei, the following experiments with various dehydrating substances were made :—

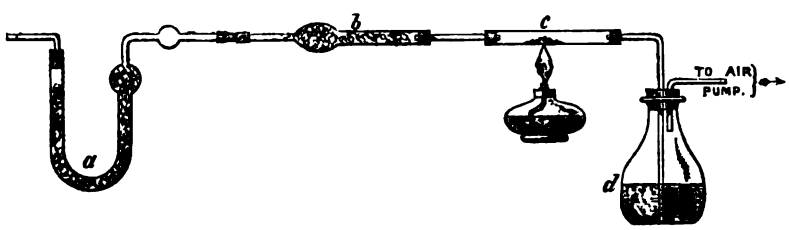
Expt. 1.—Placed some calcic chloride in a thin glass bulb, fused the chloride within the bulb, then sealed up the tail, and cleaned the exterior of the bulb by holding it by a pair of forceps in a spirit lamp flame; then dropped it into a flask containing the supersaturated solution. No effect was produced, thus showing that no nuclei were carried in by it; the bulb was then broken by means of a clean glass rod. The solution now had free access to the calcic chloride, but no effect was produced, the solution still remaining liquid.

Expt. 2.—Quick-lime was heated to redness in a bulb, and the experiment conducted as last. No effect.

Expt. 3.—Crystals of chromic acid were likewise tried. No effect.

Expt. 4.—Phosphoric anhydride was also employed, but still without determining the crystallisation of the salt.

FIG. 1.



a. H_2SO_4 tube; pumice stone.
b. Tube of cotton wool.
c. Tube containing P.
d. Supersaturated solution.

Expt. 5.—The apparatus as sketched (Fig. 1) was then set up.

While the solution was still hot, air was drawn through the apparatus for some little time, so as to effect the removal of nuclei from the apparatus itself. On the solution becoming cold, air was again caused to pass through, to ascertain the efficiency of the cotton wool and sulphuric acid tubes as filters; they answered perfectly, for no nuclei gained access to the solution. Now the phosphorus was ignited, and a gentle current of air drawn through, carrying with it the phosphoric anhydride thus formed; but, as in the case of the experiments with bulbs, the anhydride had no effect upon the solution. On removing the filter of cotton wool, and again exhausting (as was to be expected), solidification immediately took place.

Several trials were then made with absolute alcohol and concentrated sulphuric acid; the contrivance sketched in Fig. 2 was used (this kind of bulb is largely used at the Royal College of Chemistry for a carbonic anhydride estimation apparatus).

It consists of a bulb tube, *a*, having a knot tied at the end, *b*; this, in conjunction with a stopper, made of a piece of india-rubber tubing and glass rod, enables you to completely control the delivery of the fluid.

The solution was allowed to cool in the flask closed by a plug of cotton wool; this plug was then removed, and the cork bearing the bulb of alcohol, or acid substituted for it; now, by loosening the glass rod stopper, the liquid under trial was run in. In the case of sulphuric acid, the smaller the drop the better, so as not to raise the temperature of the salt solution. But, as was anticipated from the previous results with calcic chloride, &c., no effect was produced.

These experiments seem to prove that nuclei do not act by *chemically* abstracting a portion of the water.

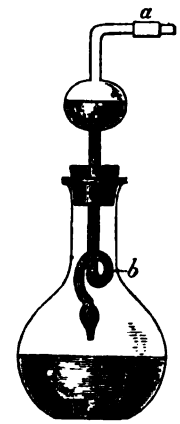
Throughout, in each and every case where the substance under experiment did not act, the solution was proved to be in good condition, by dropping into it a dirty crystal or rod.

It next occurred to me, that perhaps the substances under trial acted as nuclei in virtue of their power of abstracting water *mechanically*, absorbing the water within their pores, and rejecting the salt.

At first, this conclusion seemed to be borne out by experiment; for, on dropping into a supersaturated solution pieces of cork, paper, wood, charcoal, cotton, silk, wool, sponge, bone-earth (fragment of a cupel), burnt clay, sulphur, &c., crystallisation was immediately set up.

And I found that if I previously soaked them in water for a few minutes, no matter how dirty and greasy they might be, they now no longer behaved as nuclei; and, to render them as dirty as possible, I rubbed them over with

FIG. 2.



grease, then rolled them on the dusty carpet; in fact, made them as filthy as possible, but still, on saturating them with water (which was used cold, and very dirty), they were rendered inactive as nuclei.

When, instead of moistening them, I placed them in the spirit-lamp flame and scorched them, their power of setting up crystallisation was also effectually destroyed.

Again, it was found that portions of wood, cork, charcoal, sulphur, &c., taken from the interior of a mass, were perfectly inactive, thus showing that the property was not inherent in the bodies themselves.

When it is found that, by simply placing a greasy rod, pellet of wool, &c., into water for a short time, they are rendered inactive, we cannot attribute their activity, before moistening, solely to the repellent action of the film of grease, for they are just as greasy, after this treatment with water, as before; if it were due to the grease, then their behaviour, before and after immersion, would be the same.

In order to ascertain what effect grease had upon a supersaturated solution the following experiments were made :—

Expt.—A glass rod was first cleaned in the spirit lamp, and then dipped into a bottle of hair-oil, and thence transferred to the flask. No effect; inactive.

Expt.—Wax was melted on a rod.* No effect; the flame cleaning both the rod and the wax.

* Since writing the above, a letter from Mr. J. G. Grenfell has appeared in *Nature* for August 4, 1870, upon the same subject.—A. L

Expt.—Wax, taken from the middle of a lump. No effect; inactive.

Expt.—Dirty wax, which previously behaved as a nucleus, after standing in water for some time was thus rendered inactive.

An active rod is not rendered inactive by soaking in methylated spirit, hair-oil, nor benzol, although themselves inactive. But sulphuric acid, hydrochloric acid, solution of ammonia, and aqueous solutions of various salts, do render such a rod inactive. The sulphuric acid may act by destroying the nuclei, while the others may furnish water to them, and so prevent them from acquiring it at the expense of the solution.

All that grease seems to do is simply to facilitate the collection of nuclei; a spot of grease on cloth is always shown up by its acquiring a different colour, due to the adhesion of dust.

From the foregoing, it appears that the substances upon which I have experimented do not themselves behave as nuclei (although other bodies, yet to be tried, must), but that, by exposure to the air, and contact with dusty objects, this property of determining the crystallisation of solutions is imparted to them.

It is highly probable that nuclei may be found to consist of minute organisms and germs floating about in the air, the activity of which is destroyed by heat and by moisture.

I have only been able to make two experiments with microscopic organisms, and they, of extremely little value.

Expt.—Dry lycopodium spores; these behaved as nuclei, or contained something else which did.

Expt.—Wet lycopodium; inactive.

Expt.—Water, containing infusoria, such as *Amœbæ*, *Vorticellæ*, *Paramæciæ*, &c.; inactive.

I may, perhaps, repeat, without attaching too great a value to the results furnished by the above experiments—(1) That it is not impossible that nuclei consist of microscopic organisms, which act by abstracting water, the action being set up at a point from which it is propagated throughout the mass; (2) that they are rendered inactive by heat, because it entirely destroys them; (3) that their action is arrested by previous saturation in water, because they then can no longer abstract water from a saline solution.

Shortly, I hope to have the results of some further experiments.

London, July 12th, 1870.

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

(Continued from p. 82).

Before making any further remarks upon the coal-tar colours, I wish to draw your attention to some of their applications to the arts.

I have told you that most of the coal-tar colours contain carbon, hydrogen, and nitrogen, and that they are generally organic bases. They differ essentially from most of the vegetable colouring matters, which contain, with but few exceptions, only carbon, hydrogen, and oxygen, and are weak acids. You will thus understand that many difficulties had to be encountered in their application for dyeing and printing, because they would not combine with the ordinary mordants used for the colouring matters of woods, as alumina and oxide of tin. These observations refer to the dyeing and printing of vegetable fibres, and not to silk or wool, as these materials absorb the coal-tar colours without the intervention of a mordant.

In silk dyeing, the principal difficulty experienced in applying the coal-tar colours was owing to their great affinity for the fibre, thus preventing the dyer from obtaining an even colour, especially when dyeing light shades.

After a time, however, it was found that this obstacle could be overcome by dyeing the silk in a weak soap lather, to which the colour had been added. This not only caused the dyeing to proceed with less rapidity, but also kept the face of the silk in good condition. Silk dyed by this process is left soft, but may afterwards be rendered hard or "scroop" by rinsing in a bath of slightly acidulated water.

This process was first used for dyeing silk with the mauve or aniline purple. It has, however, been since found suitable for nearly all the aniline colours, as magenta, Hofmann, and Britannia violets, &c. For dyeing silk with coal-tar colours of an acid nature, such as picric acid, dinitronaphthol, &c., the silk is simply worked in a cold aqueous solution of the colouring matter, sometimes slightly acidulated, as when using the sulphoacids of aniline blue or soluble blue. The process of printing silk with aniline colours is comparatively simple. An aqueous or alcoholic solution of the colouring matter is thickened with gum senegal, printed on with blocks, and, when dry, exposed to the action of steam for about half an hour. The gum is then washed off, and the goods finished.

In my last lecture I referred to the formation of two colourless products from magenta, the one called leucaniline, and the other hydrocyanrosaniline.

Some few years since, it was found that if silk dyed with magenta has the reagents necessary for the formation of these colourless products printed upon it, what is called a discharge style can be produced. One of the substances used for effecting this change is powered zinc mixed with gum. This process also applies to all the coloured derivatives of magenta, and yields better results than can be obtained by printing on the colouring matter and leaving the white parts, because the colours are always clearer when dyed than when printed. But this is not all. When printing two colours on silk, say a pattern with a green ground and purple spots, two blocks have to be used, the one for the ground and the other for the spots; and, when removing the first block, the silk often moves slightly; therefore when the spots are put in by the second block, they do not exactly register, and thus an imperfect result is obtained. This difficulty, however, can be avoided by taking silk dyed with any of the derivatives of magenta, and printing it with the discharge previously mixed with the colour it is desired to introduce, of course employing a colouring matter which is not affected by the discharge, as aniline purple, aniline pink, &c. This discharge style has only been employed for silk at present.

We will now turn our attention to the methods of dyeing wool. These methods, as a rule, are very simple, the wool being merely worked in a hot aqueous solution of the desired colouring matter, no mordant being required. Acids are generally found to be injurious, a neutral bath being preferred, and the operation finished by bringing the temperature nearly up to that of boiling water.

With the blue known as Nicholson's blue, the process of dyeing is different to that just given, and consists of two distinct operations, the wool being first worked in an alkaline solution of the colour, which gives it a kind of grey or slate shade, and then in an acid bath, which developes the colour.

The printing of wool is similar to that of silk, the colouring matter being simply thickened with gum, printed on the goods, steamed, and then washed.

The dyeing of cotton with aniline purple at first presented many diffiulties. This colouring matter was found to be capable of producing a very beautiful colour without a mordant, and it was proposed to employ it in this manner, but the colour thus obtained would not bear washing, being nearly all removed with hot water and soap. Mordants, such as alum, were then experimented with, but these gave no results. After some time Mr. R. Pullar and myself found a method of applying this colouring

* The Cantor lectures, delivered before the Society of Arts.

matter to cotton, which is based upon the insolubility of the compounds it forms with tannin. In using this process the cotton is first soaked in a decoction of sumac or some other tannin agent, then in a solution of stannate of soda, and, lastly, in water, slightly acidulated with sulphuric acid. The cotton thus prepared contains an insoluble compound of tin and tannin, and which possesses a great affinity for aniline purple. The stannate of soda may be replaced by alum, or a solution of tin salt. This method of preparing cotton has been found suitable for nearly all the aniline colours discovered since the mauve, and is now almost universally employed in Great Britain for cotton dyeing. Other processes have been proposed for cotton dyeing, but are not so generally employed as the one just described.

We now pass on to the application of coal-tar colours to the art of calico printing. The mauve, when first introduced, was applied to printing in a very simple manner; the colouring matter was merely mixed with gum and albumen, printed on the goods and steamed; by this process the albumen became insoluble, and fixed the colour. Caseine and gluten were sometimes used as substitutes for albumen. Being dissatisfied with this mechanical mode of applying aniline purple, in conjunction with Mr. Grey, I made a number of experiments with a view of obtaining some more chemical method of fixing this colouring matter, and at last succeeded. The process proposed consisted in printing the pattern with a salt of lead, then converting this into the oxide or a basic salt, by passing the goods through an alkaline solution. Thus prepared, they were worked in a boiling solution of aniline purple in soap. In this way a very pure colour was obtained on the mordanted parts, the soap keeping the whites pure. This process, however, was of very limited application, as it could only be applied for single-colour patterns. After this, several processes were patented for the use of tannin for fixing the mauve; these were based upon the method of dyeing cotton previously mentioned, and some very fast results were obtained, but as these methods are now out of use, I will not describe them further.

The process now nearly universally employed in the north was discovered by M. Alexander Schultz and myself; it consists in printing the colouring matter with a mordant composed of a solution of arsenite of alumina in acetate of alumina. On steaming the cloth printed with this mixture for about half-an-hour, the colour is firmly fixed in the fibre. After steaming, the goods are generally soaped, and then finished. One of the great advantages of this process is that it can be worked in patterns with a great variety of colours, and is also suitable to nearly all the aniline colours, as well as the mauve, yielding shades of great brilliancy.

During the last few years, much attention has been given to the application of aniline black to calico printing. This substance is not prepared in the separate condition, but formed on the fabric; it is produced by printing a mixture of a salt of aniline, chlorate of potassium, and sulphide of copper, thickened with starch, upon the goods, and in this manner a dull grey impression is obtained; but, after three or four days ageing, this changes to a dark olive, and is then rendered perfectly black by passing the goods through a dilute solution of carbonate of soda. This colour is very fast, but is inclined to acquire a slightly green shade by long exposure to the air. Unfortunately, it cannot be printed on with other colours, because, when steamed, the cotton is destroyed by the acid character of the mixture employed for its formation. It can, however, be printed on at the same time as madder mordants, and these can be afterwards dyed with a lead mordant, so that when passed through bichromate of potassium, a pattern with black and yellow or orange can be obtained.

The aniline colours have produced quite a revolution in the arts of dyeing and printing, and have made these processes far simpler than they were, and there is such a variety of shades of colour now sent into the market, that the dyer or printer has little else to consider than the intensity of the colour required; and, in fact, if a dyer has a large order to execute of a particular shade of colour not in the market, he will not trouble about matching it himself, but sends to the colour manufacturer to supply him with a product capable of yielding the required shade.

Besides dyeing and calico-printing, several other branches have benefited by the coal-tar colours, such as the arts of lithography, type-printing, paper-staining, and colouring, &c. Before they could, however, be used for these various purposes, it was necessary that they should be made into lakes or pigments, by union with alumina or other suitable base; but, as most of the aniline colours are of a basic nature, it was found impossible to combine them directly with a metallic oxide like alumina; advantage was, therefore, taken of their affinity for starch granules, and some very brilliant products were obtained by dyeing powdered starch with the cold aqueous solution of these colouring matters. These starch powders, however, are wanting in covering power or body, so that other processes had to be sought for, and now these lakes are made upon an alumina base, by the intervention of tannin or benzoic acid.

Many attempts have been made to prepare a pigment from rosolic acid or aurine, and this, to some extent, has been accomplished by precipitating a solution of the colouring matter with alumina; by this process, a bright orange-scarlet coloured product can be obtained; it is, however, only suitable for paper-staining. I have, therefore, lately been further experimenting in this direction, and have succeeded in forming a very brilliant scarlet pigment, which can be used for printing inks and a variety of other purposes.

Upon the table there are some specimens of magenta, Britannia violet, aniline blue, green and orange lakes, and also some very beautiful and intense-coloured preparations of coal-tar colours, now generally called carmines. These lakes, when ground with printers' varnish, produce printing inks of very great brilliancy, and are extensively used for this purpose; and Mr. Hanhart, whose name is so intimately connected with the art of lithography, has most kindly furnished me with the various illustrations of the application of these products to lithographic printing for this lecture.

These lakes, in a wet condition, are being largely used for paper-staining, acd also for paper-colouring, as well as for a variety of other less important purposes.

The peculiar bronze surface produced by evaporating a solution of an aniline colour, has been taken advantage of by the manufacturer; and all the bronze bonnets, hats, flowers, and feathers, so much worn in the autumn of last year, derived their lustre from aniline colours. When first employed for this purpose, no fixing agent was used with them; and, as they are mostly soluble in water, a shower of rain was often found to cause beautiful purple drops to fall from these bronzed bonnets and hats, and produce a kind of mottled pattern upon the white collars, and sometimes even upon the face of the wearer.

Aniline colours are used for writing inks, colouring soap, &c.; but, as these applications are only of small importance, in a commercial point of view, I will not spend time in speaking about them.

(To be continued.)

MISCELLANEOUS.

London Institution.—On the 10th inst., Dr. J. P. Gassiot, F.R.S., one of the Vice-Presidents of this Institution, distributed the prizes awarded, and certificates granted, to students who passed the examinations in Physics, Chemistry, and Botany, based upon the courses of Educational Lectures delivered, during the past session, by Professors Guthrie, Bloxam, and Bentley. First-class

prizes were obtained by Edmund Strode, A. J. Richardson, and Emma Ball; second-class prizes by T. Lyon, Esther Greatbatch, Annie Piper, Isidore Harris, E. M. Hutton, A. J. Wallis, and Ellen Benham. Dr. Gassiot stated that Professor Odling had consented to open the coming session with a course of Educational Lectures, "On Chemical Action," and that after Christmas Professor Huxley would deliver a course, "On the First Principles of Biology."

Utilising a Burning Coal-Mine.—In the environs of Dudley there was formerly a coal-mine on fire. The snow melted in the gardens as soon as it touched the ground. The gardeners gathered three crops a year; even tropical plants were cultivated; and, as in the Isle of Calypso, an eternal spring prevailed. In another Staffordshire colliery, the firing of which dates many years back, and which is called by the inhabitants "Burning Hill," it was noticed, as at Dudley, that the snow melted on reaching the ground, and that the grass in the meadows was always green. The people of the country conceived the idea of establishing a school of horticulture on the spot. They imported colonial plants at a heavy expense, and cultivated them in this kind of open-air conservatory. One fine day the fire went out, the soil gradually resumed its usual temperature, the tropical plants died, and the school of horticulture was under the necessity of transferring their gardens elsewhere.—*Underground Life.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 8' 1870.

This number, an unusually small one, contains the following original papers relating to physico-chemical and collateral sciences:—

Relation existing between the Specific Heats and the Co-efficients of Expansion of any Substance.—M. Phillips.—An algebraico-physical paper.

Decimal Division of the Quadrant.—A. D'Abbadie.—Abstracts of two letters on this subject from MM. Radau and Airy.

Estimation of the Rapport of the Two Specific Heats of Gases.—MM. Jamin and Richard.

Reply to the Papers Published by H. Sainte-Claire Deville on the 18th of July last.—M. J. Jamin.—Algebraico-physical papers.

New Experiments on the Armatures and the Fixed Plate of Holtz's Electrical Machine.—M. Laborde.—The author describes some of the experiments made by him with a Helmholtz machine, made by converting an ordinary electrical machine.

Lithological Map of the Mouth of the Seine.—M. Delesse.—This map represents the geological formations met with at the mouth of the river above named, and along a portion of the coast. It appears that the same geological formations which are predominant in the parts of France bordering on the sea, in the vicinity of the mouth of the Seine, extend to a great distance under the sea.

Researches on the Toxicological Effects of the M'Boundou, or Icaja, a Poison in Use at Gabon.—MM. Rabuteau and Peyre.—It appears that, at Gabon, a French settlement on the west coast of Africa, there is in use a vegetable poison, locally known as *m'boundou*, or *icaja*. That substance is the root of a plant which is not further specified. The authors have been experimenting with this substance, which, even in very dilute decoctions, is very bitter, and appears to contain one or more alkaloids, since the aqueous decoction is largely precipitated by iodide of potassium, and also by phospho-molybdic acid. The poisonous effects of this substance bear some similarity to the effects of brucia, but the authors state that, under certain conditions, this poison does not hurt men. Some of the lower animals are readily killed by it; a dose of 3 milligrms. of the alcoholic extract, placed under the skin of a frog, kills it; and rabbits and dogs are killed by doses of from 15 to 25 centigrms. of the same extract introduced into the stomach.

The larger portion of the time this meeting lasted has been devoted to discussion on the *Phylloxera vastatrix*, and the best means of getting rid of them from the vineyards. The President announced that the next meeting would take place on Tuesday, the 16th, instead of on Monday, the 15th of August, in consequence of the last-named day being a high festival day. The election of a new corresponding member for the Natural History Section is postponed for three months.

Revue Hebdomadaire de Chimie, July 14, 1870.

Delaurier's Galvanic Element with only One Liquid.—The description, elucidated by a cut, of a galvanic cell composed of zinc and carbon placed in a fluid made up of 40 parts of water, 4·5 parts of bichromate of potassa, 9 parts of concentrated sulphuric acid, 4 parts of sulphate of soda, and 4 parts of the double sulphate of potassa and iron. This element produces a very regular current. The zinc need not be amalgamated, and no gas is evolved.

Galvanometer with Vertical Needle.—M. Bourbouze.—The author's description of this instrument is illustrated by woodcuts. The chief aim of this contrivance is to render slight deviations of the needle visible to a large number of students at a time.

July 21, 1870.

Estimation of Nitrates in Potable Waters.—M. Scheurer-Kestner.—The author has tested a method for this purpose, originally devised by Dr. Goppelsroeder, and executed in the following manner:—To 50 c.c. of the water to be tested for nitrates are added 100 c.c. of concentrated and pure (free from nitrous compounds) sulphuric acid; to this mixture, which becomes very hot, a weak solution of indigo is added from a burette. The fluid becomes yellow, and, at the end of the operation, green-coloured. The author of this paper does not state the means of titrating the indigo solution, so as to render its use a suitable means of quantitative estimation; but he simply states that, after proceeding with the experiment as just mentioned, another experiment is made, wherein, instead of the addition of sulphuric acid to the water, there is added to it the quantity of c.c. of indigo solution first found necessary to produce a reaction.

Description of an Apparatus for the Continuous Preparation of Carbonic Acid, and of Lime, by One Operation.—A. Perret.—This paper, accompanied by woodcuts, describes, at length, a contrivance especially suited for beet-root sugar works, to decompose, by the joint agency of red-heat and steam, limestones in such a manner as to make the escaping carbonic acid gas available for use in the beet-root sugar manufacture.

Les Mondes, July 21, 1870.

Higher Public Instruction in France.—From a circular addressed to the recteurs by the Minister of Public Instruction, it appears that the French Government intends to lay out a large sum of money for improving, repairing, and completing the buildings (inclusive of laboratories, botanical gardens, &c.), museums, and scientific collections, libraries included, and for the expenses of heating and lighting rooms, halls, and other places adapted to the use of the various divisions of the Université de France, and the colleges and schools connected therewith.

Utilisation of Vine-Leaves and Cuttings of Young Vine-Twigs.—J. Guyot.—It appears that the materials alluded to are now partly given to the cattle in fresh state, and are partly salted for winter forage. Since France possesses 2,500,000 hectares of vintage-ground, the green materials mentioned will yield, according to the author, a sufficient quantity of food for cattle, at the rate of 20 kilos. per head for at least 100 days.

Geological Alpine Congress.—A number of scientific men, inhabitants of the Helvetian Republic, intend to hold, on August 31st and two following days, at Geneva, a meeting, chiefly with the view of starting a well-planned geological study of the larger chain of the Alps by Swiss, French, and Italian geologists. The well-known M. F. J. Pictet is one of the promoters of this meeting.

July 28, 1870.

Crystallisation of Iron and Steel.—Dr. Schott.—The author has examined a large number of samples of iron and steel, microscopically, and states that his observations lead him to consider that, the more regular and small the crystals are of which iron and steel are always composed, the better the metal. Moreover, in the good qualities of these substances the crystals are placed very regularly near each other.

Uniformity of Time for Military Camps.—Rev. F. Moigno.—The author discusses, but does not exactly describe, an instrument which appears to be of great utility for regulating and adjusting clocks and watches, and which is so portable and readily put together that any soldier may be left in charge of it. The price of this piece of mechanism is only 22 francs annually.

August 4, 1870.

Hygienic Vinegars.—A. Servel.—The author purifies wine vinegars, by a series of operations, not specified, so as to render them highly pleasant, strong, agreeably acid liquids, especially adaptable to being mixed with water, and thus rendering it (even when otherwise rather unpleasant) a refreshing, wholesome, and thirst-quenching fluid, highly recommended above the use of spirits in armies and navies,

also on account of the tonic properties the vinegars alluded to appear to possess.

Economical Candles.—M. Sokolnicki.—A paper, illustrated by several woodcuts, on the best plan for the manufacture of candles so as to make them give the most and best light and provide for complete combustion of the materials they are made of, with the least possible expenditure at the same time.

New Electric Battery Invented by M. Chutaux.—(Reported on by R. Francisque-Michel.)—A lengthy report, illustrated by a series of woodcuts. It appears that the results obtained are—

	Electromotive force.	Internal resistance.
Chutaux battery	11·400	6·00
Marié-Davy battery	8·192	5·50
Daniell battery	5·973	9·31
Peroxide of manganese battery	7·529	4·00

Cosmos, July 30, 1870.

Historical Facts about Potatoes.—Marshal Vaillant.—This well-known vegetable, first imported into Europe from Peru by Francis Drake, remained a very long time almost unknown; it was not cultivated in Germany until after 1710, and then only in gardens. Its introduction into France, from Germany, dates about 1749, and it never was generally introduced in the last-named country until about 1820. In the south of France, potatoes are comparatively rare, and rather an expensive vegetable, as compared with lentils, beans, &c.

Purification of Dirty Water.—S. Meunier.—Since, in dry seasons, any water may be of high value, at least for cattle-drinking, the author advises to place, in a large-sized cask, a false bottom perforated with some holes; and to put on that bottom, first, clean pebbles, next, well-washed sand, then a layer of coarsely-granulated charcoal, and over all this a piece of canvass. The water, even that accidentally standing in shallow ditches after a shower of rain, may be poured into this filter, and thus become available for cattle-drinking, though it may not be quite clear.

August 6, 1870.

Cause of the Fatigue to the Eyes caused by Artificial Light.—V. Meunier.—The author states that the great difference between sun and artificial light is due to the fact that, of the light emitted from the former, about half the quantity of rays are luminous and calorific at the same time; but, as regards our artificial light, for ordinary oil (colza oil), the amount of non-luminous, yet calorific, rays is 90 per cent; for white-hot platinum, 98 per cent; alcohol flame, 99 per cent; electric light, 80, and gas-light, 90 per cent; while for petroleum and paraffin oils, the amount is 94 per cent. It is this large quantity of caloric rays in artificial light which causes the fatigue to the eyes; but this inconvenience may, according to the author, be almost entirely obviated by intercepting the thermic rays by glass, or, better yet, mica plates. The use of these renders the light soft and agreeable to the eyes.

Possibility of Obtaining Luminous Signals Visible at Great Distances.—Dr. Delaurier.—The author proposes the use of galvanic electricity, so applied as to have the effect of producing what, in light-house terminology, is known as "flashing light." The idea of the author is to bring this into practice by means of a peculiar induction apparatus, so contrived as to cause the least possible expenditure of electricity, and to interrupt the current, so that only by the passage of a spark between the carbon-points at intervals of from two to five seconds of time, a luminous flash be produced, visible, even in foggy weather, at a great distance.

New Use for Hyposulphite of Soda.—S. Meunier.—The author states that experiments made with this salt have proved it to be very superior for use for washing linen to the carbonate of soda now in use; it has no corrosive action, and does not cause a yellow colouring of the fabrics after some time. Borax, largely used in the Netherlands and Belgium, is a better substitute still, and, by its use, white fabrics assume an agreeable bluish hue, which, in many instances, renders the subsequent use of washing-blue unnecessary.

A New and Highly-Recommended Book.—At one of the late meetings of the French Academy, M. Dumas spoke in highly-eulogising and, to the author, complimentary terms, on the work just published by M. Louis Figuier, which bears title, "Armes de Guerre et Bâtiment Cuirassés." In this work, illustrated by 237 engravings, the author gives an accurate description of all the contemporaneous arms of war—various kinds of guns, pistols, &c., mitrailleuses inclusive, and of iron-clad ships, as in use by different nations. The price of this book is 3 francs 50 centimes.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, May, 1870.

This number contains the following original papers relating to chemico-physical and collateral sciences:—

Some New and Remarkable Properties of the Diametral Conductors of the Electro Machine, and Description of a New Kind of Double Machine the Construction of which is Based upon a New Principle.—Dr. J. C. Poggendorff.—A lengthy memoir, accompanied by engravings.

Composition of the Meteorites of Shalka and Hainholz.—Dr. Rammelsberg.—This paper is chiefly written with the view of proving that the assumed existence of a peculiar mineral, which was named shalkite, and obtained from the meteorite of Shalka (Bengal, where the stone fell on the 30th of November, 1850), is erroneous, inasmuch as the author's analysis of this meteorite proves it to be, mineralogically, a mixture of broncite, olivine, and chrome-iron ore; while the Hainholz meteorite (the time when this mass fell is uncertain; the stone was found in 1856, near Paderborn, Prussia, by Dr. Mühlenpfordt) also consists of olivine and broncite, in addition to meteoric iron. The lengthy memoir contains the results of a series of analyses of the meteorites alluded to, but space forbids us to enter into more details here.

Journal de Pharmacie et de Chimie, July, 1870.

This number contains the following original papers and memoirs:—

Method for Readily Testing the Fatty Oils.—Dr. Massie.—In order to test the purity of the oils, the author employs nitric acid (sp. gr. of from 1·38 to 1·41) and metallic mercury. Five grms. of this acid, and 10 grms. of the oil to be tested, are mixed together in a test-glass of 100 c.c. capacity, and the mixture stirred for a couple of minutes. The liquid is then left standing; and, when the fluid has separated into two layers, the colour of these layers is noted. This colouration may be from greenish white to deep brown for the superior, or lighter layer; while the colouration of the acid, always less intense, will vary from light yellow to deep yellow, or even rose-red. After a while, 1 grm. of metallic mercury is added, the final result of which addition will be the solidification of the bulk of the oil in most cases. There is added to this paper a lengthy series of description of the phenomena observed when various oils, and mixtures of different oils, are treated by the reagents alluded to; but it does not appear that the ultimate result is such as to definitely and absolutely render it possible to recognise and detect adulterations of oils. The test is only of a relative value.

Extract from a Report on a New Process of the Quantitative Estimation of Quinine in Barks.—Dr. Carles.—The editors of this periodical state, in a foot-note, that they will shortly publish the author's memoir in full.

Chemical and Therapeutical Researches on the Thermo-Mineral Water of the Solfatara at or near Pouzzoles (Herault, France).—S. de Luca.—One litre of this water contains, in grammes' weight—Sulphuric acid (calculated anhydrous), 1·473; chlorine, 0·0085; protoxide of iron, 0·1105; lime, 0·101; magnesia, 0·0225; potassa, 0·017; ammonia, 0·0135; alumina, 0·335; silica, 0·315; soda, manganese, arsenic, and organic matters, traces; water, 997·603. This water may be industrially applied for the manufacture of alum.

Test for Detecting the Presence of Guaiacum Resin among the Resin of Jalap.—Dr. Blacher.—The author puts 50 centigrms. of guaiacum resin, and 20 centigrms. of oxide of copper, in a porcelain mortar, and adds about 20 drops of alcohol. When this mixture is triturated, nothing particular is seen, but, as soon as about 15 drops of ammonia are added, a beautiful apple-green colouration is produced. When this experiment is repeated with resin of jalap, no such green colouration whatever is seen; the mixture remains brown-coloured.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., Nos. 5 and 6.

These numbers contain the following papers relating to chemistry and allied sciences:—

Influence of Heat upon the Elasticity of Caoutchouc.—J. Schmulewitsch.—An algebraico-physical essay.

Derivatives of the Isocaprin Series.—A. Borodin.—This paper treats chiefly, and at great length, on the products of the oxidation of a new monatomic alcohol, $C_{10}H_{22}O$. The main product obtained by the author is an aldehyde, a liquid boiling at 147°, and not frozen even at −37°; sp. gr. at 0°, 0·82783; formula, $C_{10}H_{20}O$. The author further describes an acid, $C_{10}H_{20}O_2$, which combines with bases, forming salts. The acid is a liquid, boiling at 241·5; sp. gr. at 0°, 0·90956 insoluble in water, but soluble, in every proportion, in alcohol and ether.

Annalen der Physik und Chemie, von Poggendorff, No. 5, 1870.

This number contains the following original papers and memoirs:—

Influence of the Ponderable Molecules on the Dispersion of Light, and on the Importance of the Constant Dispersion Formulæ.—E. Ketteler.—The continuation and end of this lengthy memoir.

Sound Emitted by Heated Tubes, and the Vibrations of Air in Tubes of Various Shapes.—Dr. C. Sondhauss.

On Chromates.—C. Freese.—In this portion of his lengthy essay, the author describes the following salts:—Chromate of copper and potassa, $Cu_2.K_2Cr_2O_{13}+2aq.$; normal chromate of zinc; basic chromate of zinc (containing, in 100 parts—ZnO, 54·12; CrO_3, 10·81; water, 11·57); chromate of zinc and potassa—

$$Zn_4K_2Cr_2O_{14}+3\,aq.=(Zn_4CrO_7+3\,aq.)+(K_2Cr_2O_7);$$

chromate and basic chromate of cadmium; chromate and basic chromate of nickel, $Ni_3CrO_6+2H_2O+aq.$; chromate of cobalt; and chromate of protoxide of manganese.

Mechanical Force Exerted by Moving Masses of Gas.—Dr. L. Boltzmann.

Calculation of the Vibrations of a String of a Musical Instrument, as referred to its Resistance to Bending.—R. Hoppe.

Figures Produced by the Action of Acids upon Certain Substances (Etching), and on the Phenomena of Asterism in Crystals.—Dr. H. Baumhauer.—Illustrated by a series of engravings.

Velocity of Molecular Motion and of Sound in Gases.—E. Mulder.

Production of Standing (Stehender) Vibrations and Sound Figures in Elastic and Fluid Liquids by the Aid of Solid-Sounding Plates.—A. Kundt.

Elastic Vibrations.—Dr. J. J. Müller.

Occurrence of Augite in Meteorites.—C. Rammelsberg.—This paper contains the following sections:—Enstatite in meteorites; broncite in meteorites; augite in meteorites.

The Lodran Meteorite.—G. Tschermak.—The anthor found this meteorite to consist, in 100 parts, of—Iron, 85·44; nickel, 12·79; magnesia, 0·81. Mineralogically, the stone consists of—Nickeliferous iron, 32·5; olivine, 28·9; broncite, anorthite, and chromite, 30·2; magnetic pyrites, 7·4 per cent.

Acoustical Attraction and Repulsion.—Dr. Schellbach.

Maximum Degree of Density and the Freezing-Point of Mixtures of Alcohol and Water.—Dr. F. Rossetti.

Best Method for Studying the Nature of Flames.—L. Dufour.—The author describes a contrivance by means of which the well-known use of a wire gauze for examining the nature of flame is replaced by a thin sheet of water.

Colours Exhibited by Iodine.—C. Schultz-Sellack.—This paper treats chiefly on the differences exhibited by the colour of iodine in thin plates, in vapour, and in solution. Iodine is deep brownish red-coloured in thin layers; its vapour is violet; and some of its solutions exhibit the former, some the latter colour.

Platinum in Lapland.—Dr. Nordenskjold.—It arpears that gold having been found some years ago in the neighbourhood of the Ivalo river (Northerly Sweden), a more recent search there has given rise to the discovery also of some platinum, which, according to a brief foot-note added to this paper, has also recently been found near Ibbenbühren, Westphalia.

Confirmative Test of the Genuineness of the Bohemian Diamond from Diaschkovitz.—A few milligrms. of this stone have been burnt in oxygen by Dr. Schafarik, in the presence of MM. Krejci, Rochleder, Waltenhofer, Zenger, and von Zepharovich. The result is that carbonic acid was given off, as proved by the turbidity caused by the products of combustion being led into baryta water, and no residue whatever being left.

The American Journal of Science and Arts, July, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Photometric Experiments.—Part II.

Amount of Light Transmitted by Plates of Polished Crown-Glass at a Perpendicular Incidence.—O. N. Rood.

The Ethers of Arsenic and of Arsenious Acid.—J. M. Crafts.—The author describes—Arseniate of ethyl, prepared by the action of the iodide of ethyl on the arseniate of silver. Arseniate of ethyl is a liquid; sp. gr. at 0°, 1·3264; it is a very unstable compound, which attracts moisture from the air, and is immediately decomposed into arsenic acid and alcohol; this body contains 33·18 per cent of arsenic. Arseniate of methyl, a liquid; sp. gr. at 14·5°, 1·5591. Arseniate of amyl. Arseniate of ethyl, also a liquid; sp. gr., 1·224; vapour density, 7·2673; this liquid is miscible with alcohol and ether, but is decomposed by aqueous alcohol. Arseniate of methyl: sp. gr., 1·428; vapour density, 5·818. Arsenite of amyl: sp. gr., 1·0525; this, and all the compounds alluded to, are not at all stable, being readily decomposed by water and moisture.

Notice of some Minerals from New Jersey.—W. T. Roepper.—The author describes, at some length—Chrysolite, a mineral containing chiefly iron, manganese, zinc, and silica, the percentage composition being—Silica, 30·76; protoxide of iron, 33·78; protoxide of manganese, 16·25; oxide of zinc, 10·96; magnesia, 7·60. Magnesian dolomite, composed, in 100 parts, of—Carbonate of lime, 50·40; carbonate of protoxide of manganese, 43·54; carbonate of protoxide of iron, 0·76; carbonate of magnesia, 5·69; insoluble, 0·08.

Miscellaneous Optical Notices.—Dr. Wolcott Gibbs.

Theoretical Temperature of the Sun, under the Hypothesis of a Gaseous Mass Maintaining its Volume by its Internal Heat, and Depending on the Laws of Gases as known to Terrestrial Experiment.—J. Homer Lane.

Mineralogical Contributions.—C. U. Shepard, sen.—The author describes, at length—A new variety of columbite, found to consist, in 100 parts, of—Metallic acids, 78·30; protoxide of iron, 13·86; protoxide of manganese, 7·72; traces of tin. Unknown mineral (microlite?) in Haddam columbite. New locality of bismuthine and bismuthite, in Haddam. Metallic acid in microlite. Redondite, a mineral found in Redonda Island, and containing 44·07 per cent of phosphoric acid, 24·73 per cent of water, and oxide of iron and alumina. Phosphoric acid in the diaspore of Chester, Mass.; the mineral here alluded to is mainly hydrate of alumina, containing only 0·32 per cent of phosphoric acid. The Pelham vermiculite contains, in 100 parts—Alumina, 14·0; magnesia, 13·68; peroxide of iron, 32·0; silica, 24·0.

Hydrogenium-Amalgam.—O. Loew.

Journal für Praktische Chemie (double number), Nos. 11 and 12, 1870.

This number contains the following original memoirs:—

Foundation of Chemistry by Lavoisier.—J. Volhard.—This valuable memoir opens, unfortunately, with an attack upon the French as a nation, by stating that they are in the habit of very greatly exaggerating the merits of their great men, and, by so doing, forgetting the real value of their labours. The author's memoir is otherwise an excellent contribution to the early history of chemistry as a science, due stress being laid upon the high value of the labours of Scheele (a Swede), Priestley, Cavendish, Black, Marggraf, Fourcroy, Vauquelin, and others.

Quantitative Estimation and Separation of Cobalt and Nickel.—Dr. E. Fleischer.—To the acid solution of both metals, the author first adds hypochlorite of soda (eau de Javelle) and solution of caustic potassa in excess; the liquid is next heated to the boiling-point; and the ebullition is continued until the precipitate has become quite black. The precipitate is collected on a filter. The mixed sesquioxides are separated from each other by the use of warm liquid ammonia, which dissolves the sesquioxide of nickel, leaving the sesquioxide of cobalt.

Action of Chloride of Chromic Acid upon Aromatic Hydrocarbons.—E. Carstangen.—This lengthy memoir is divided into the following sections:—Introduction; action of chloride of chromic acid upon naphthaline, anthracen, toluol, xylol, mesitylen, diphenyl, phenol, nitrobenzol, aniline.

Crystalline Pigment of Turmeric Root.—Dr. F. W. Daube.—This paper has been already alluded to, having been abstracted from another German periodical (see CHEMICAL NEWS, vol. xxii., p. 84); but the paper, as published in the above-named periodical, contains, besides, the following brief notice relating to the essential oil of turmeric root:—Forty pounds of the Bengal root yielded, when treated with steam, 400 grms. (about 2 per cent) of the essential oil, which is to be further investigated by Dr. Claus.

Revue des Cours Scientifiques de la France et de l'Etranger, July 23, 1870.

This number does not contain any original papers relating to chemistry or collateral sciences, but we learn that Professor Helmholtz, appointed to succeed the late Professor Magnus, at Berlin, will not leave for that place until the month of April next, it being his desire to stay the winter at Heidelberg.

NOTES AND QUERIES.

Condensing Hydrochloric Acid Gas.—(Reply to "Salt").—Consult Richardson and Watts's "Chemical Technology," vol. i., part 3.

Brewing Queries.—(Reply to T. Gregson).—Consult "Theory and Practice of Brewing," by W. L. Tizard (London, 1854), which you can inspect at the Library of the Commisioners of Patents.

Estimation of Alkalies in Silicates.—"Analyst" will find a full description of Dr. Lawrence Smith's method of estimating the alkalies in silicates in my "Manual of Chemical Analysis," p. 473. I have been using this method rather extensively lately in the analyses of fire-clays and bricks, and can recommend it as both simple and accurate. I mix 50 grains of the clay or brick with 250 grains of carbonate of calcium and 30 grains of chloride of ammonium, and heat to bright redness in a platinum crucible for half an hour; neither fusion nor a higher temperature than bright redness are necessary. I obtain the carbonate of calcium pure, by precipitating pure chloride of calcium by carbonate of *ammonium*; neither carbonate of sodium nor carbonate of potassium must be used, it being impossible to free the precipitated carbonate of calcium from either of these alkalies by any amount of washing. To prove this, I may mention that, having found in a sample of carbonate of calcium, which had been precipitated by carbonate of sodium, nearly 1 per cent of carbonate of sodium, I washed it almost uninterruptedly for several days with boiling distilled water, but failed to remove any material quantity of the alkali.—HENRY M. NOAD, St. George's Hospital.

TO CORRESPONDENTS.

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J. Wallace Young.—"Traité des Matières Colorantes, comprenant leurs Applications à la Teinture et à l'Impression; et des Notices sur les Fibres, Textiles," &c., par P. Schiitzenberger; 2 vols., 19s. Paris: 1867; V. Masson.

F. W. Thomson.—We believe the work you allude to is out of print.

W. H. Perkin.—Received, with thanks.

F. G. Cooper.—Your request has received attention.

J. S. Sellon.—Received.

J. C. Brough.—Thanks for your communication.

THE CHEMICAL NEWS.

VOL. XXII. No. 561.

NUCLEI AND SUPERSATURATED SALINE SOLUTIONS.

By ARCHIBALD LIVERSIDGE,
Associate of the Royal School of Mines.

PROFESSOR TYNDALL has shown, by means of the beam from an electric lamp, that the minute particles of dust which ever float in the disturbed air, may be effectually arrested by means of a cotton wool filter; he therefore recommends (*Nature*, vol. i., p. 342) the use of cotton wool respirators as a defence against contagion, since they would completely intercept the dirt and germs borne by the atmosphere.

In order to ascertain if there were any real necessity for such respirators—in fact, to prove the filtering power of our natural respirator, the nose—the following experiment was performed:—

Expt.—A flask containing a supersaturated solution of sodic sulphate was fitted up as a Woulff's bottle; whilst the solution was cooling the apertures of the two tubes were plugged with cotton wool. When the solution was cold these plugs were withdrawn, and air which had been respired through the nose was forced through the solution.

In some cases the current of air was maintained for ten or fifteen minutes. The solution was kept cold by the immersion of the flask in water, for if the temperature had been allowed to rise by the absorption of heat from the breath the experiment, would, of course, have been vitiated.

No effect was produced, thus showing the perfect efficiency of the hairs and mucous membranes lining the nasal passages in arresting nuclei.

When we inspire through the mouth, the dust of the air has a free and unimpeded course to the lungs, where it settles and clogs up the delicate air passages with putrescent matter. Not only is the air purified by inhaling it through the proper channel, but it is warmed also.*

In an abstract of one of his papers (CHEMICAL NEWS, vol. xix., p. 128) Mr. Tomlinson explained the sense in which he applied the term catharism or "chemical cleanness" in contradistinction to ordinary cleanness, by stating that the finger could not possibly be made clean (*i.e.*, inactive as a nucleus) by any process, whereas a glass rod could be.

Regarding the finger as a greasy rod, I could see no reason why it should not be made inactive in the same way as a glass or other rod.

Expt.—Held the finger in water for a minute or so, then transferred it to the supersaturated solution. No effect.

Expt.—Passed the finger through a spirit-lamp flame several times, then immersed it in the solution. No effect.

Hence, the finger is readily made to behave as if it were catharised.

In the last number of the CHEMICAL NEWS (p. 88), Mr. Tomlinson states that oil and fatty bodies, whether chemically clean or not, do not act when in mass, as globules, &c., but only in thin films.

For my part, I have never found that the quantity or form of the oil, &c., has ever had any effect upon the behaviour of the salt in solution. Many times the oil or fat has been spread over the surface of the solution as a thin film, even thin enough to be iridescent, and the internal surface of the flask has also been coated in the same way, but this has not determined the solidification of the salt.

Then again, on the same page, he says, oils and fats are chemically clean which are chemically pure. Does not the following refute this statement?

Expt.—A mixture of wax, oil, soot, dust from floor, sulphur, sodic sulphate, soap, &c., was melted together on a glass rod and then dipped into the supersaturated solution. No effect.

The oil and fat in this case were certainly not chemically pure; therefore, according to Mr. Tomlinson, they ought not to have been chemically clean, *i.e.* inactive; but they were inactive nevertheless.

Might I suggest that it would, perhaps, be as well to do away with the terms "chemically clean" and "catharism," for if my results be trustworthy—and I have been at much pains to make them so—the conclusion to be derived from them is that there is no connection whatever between the active state of a nucleus and its want of chemical purity; a pure chemical or other pure body is just as quickly rendered active as a nucleus by exposure to the air or by contact with objects which have been so exposed, as is a substance composed of the most heterogeneous mixture imaginable,* and they may both, with equal facility, be re-converted into the inactive state on exposure to a sufficient heat or to moisture.

Although in my former paper I suggested, and do still, that nuclei may be found to consist of microscopic organisms, I do not quite reject M. Gerner's hypothesis that the nuclei may consist of universally diffused particles of the sodic sulphate, but in what state it exists and exerts its influence has not yet been shown. Mr. Tomlinson has pointed out that it is not in the form of the anhydrous salt, nor is it that with seven atoms of water, since you obtain both these salts nearly every time you prepare a supersaturated solution; and ignited sodic sulphate is certainly not a nucleus. All we can do is to still apply questions and extort an answer from nature.

London, August 19th, 1870.

* See a letter upon this in *Nature* for Feb. 17, 1870.

ON THE

FUNCTIONS OF NUCLEI WITH RESPECT TO SUPERSATURATED SALINE SOLUTIONS.

By CHARLES TOMLINSON, F.R.S.

I TRUST it will not be thought disrespectful to fellow-workers in the same field, if I refer them to my paper on supersaturated solutions, which was read before the Royal Society on the 16th June last, an abstract of which is printed in the *Proceedings*, No. 122, page 533.

I think it will be found that the line of experimental research adopted by Mr. Grenfell, and also by Mr. Liversidge, had been anticipated by me; but it would afford me the highest satisfaction if such able observers would review their work with reference to my latest results.

It will be seen from my note, in answer to Mr. Grenfell, that my definition of *chemically clean* applies to all bodies, including oils and solid fats. If a stick of tallow be chemically clean it will not act as a nucleus, because the solution adheres to it as a whole; but a film of tallow will act powerfully. So, also, a globule of castor oil will not act if chemically clean, but a film of it will act as a nucleus.

If a drop of a liquid be placed on the surface of a supersaturated saline solution, it will (apart from chemical action) do one of three things; (1) it will diffuse through the liquid, and in general not act as a nucleus, as in the case of glycerin; (2) it will spread out into a film; or (3)

* There is nothing to prevent each of the constituents being itself chemically pure, and if each, when separate, is inactive, why should the mixture not be inactive also?

remain in a lenticular form. It becomes a film or a lens according to the general proposition, that if on the surface of the liquid A, whose surface tension is *a*, we deposit a drop of the liquid B, whose surface tension, *b*, is less than *a*, the drop will spread into a film; but if, on the contrary, *b* be greater than *a*, or only a little less, the drop will remain as a lens. The *superficial viscosity* of the solution may in some cases interfere with the rigid application of this proposition.

An active, or non-catharised surface, is one contaminated with a film of foreign matter, the filmy condition appearing to be necessary to secure that close adhesion which brings about the nuclear action.

Some liquids, such as alcohol, form films and act as nuclei by separating water instead of salt from supersaturated solutions.

Fatty oils may saponify, or oil of bitter almonds form benzoic acid, in contact with supersaturated solutions of Glauber's salt without acting as nuclei.

When a drop of a fatty oil spreads out into a film on the surface of a cold supersaturated solution of Glauber's salt, very fine prismatic plates of the ten-atom salt, with dihedral summits, fall from every part of the lower surface of the film; an effect quite different from the crowded diverging mass of crystalline needles which proceeds from a point in the surface when a speck of dust is let in, or the surface is touched at one place.

Liquids such as ether, alcohol, naphtha, benzol, oil of turpentine, cajuput, and other volatile oils; sperm, herring, seal, olive, linseed, castor, and other fixed oils, act powerfully as nuclei when they form films; but when they form lenses there is no separation of salt, even though the flask, being whirled round, so as to break up the lens into small globules. But if, by a sudden jerk, a globule of oil be flattened into a film, the solution immediately becomes solid.

"Stearine from sheep's tallow that had been exposed to the air produced immediate crystallisation; but by boiling the solution, and covering the flasks, the stearine, now catharised, had lost its nuclear character in the cold solution. Similar observations were made with the fixed oils that form lenses or globules in the solution. So also volatile oils, containing products of oxidation, dust, &c., are nuclear, but when catharised, by being re-distilled, they are inactive in the globular state, active in the form of films.

"When a liquid forms a film on the surface of a supersaturated solution, the surface-tension of the solution is so far diminished as to bring the film into contact with the solution, when that differential kind of action takes place, whereby, the salt of the solution adhering more strongly to the film than the water of the solution, the action of separation and crystallisation, thus once begun, is propagated throughout. A similar action takes place with solid bodies that have contracted filmy nuclei, by being touched or drawn through the hand, or merely exposed to the air; they are active or nuclear by virtue of the films of matter which more or less cover them.

"On the other hand, when a drop of oil (or many drops) is placed on the surface of a supersaturated saline solution, and it assumes the lenticular form, or even flattens into a disc, such lens or disc is separated from actual contact with the solution, by surface tension. That the adhesion is very different from that of a film may be shown by pouring a quantity of recently distilled turpentine, for example, on the surface of chemically clean water, and scraping upon it some fragments of camphor; these will be immediately covered with a solution of camphor in the oil, which solution will form iridescent films, and sail about with the camphor, vigorously displacing the turpentine, and cutting it up into smaller discs and lenses. So in the case of supersaturated saline solutions, the oil-lens is not sufficiently in contact with the surface of the solution to allow of the exertion of that differential kind of action whereby salt is separated. Even when by shaking, the oil is broken up into globules, and these are submerged, they are still so far separated from the solution by surface-tension as to prevent actual contact."*

It should be remarked that, in experiments on the action of nuclei on supersaturated saline solutions, the flasks must on no account be plugged with cotton wool, because in removing the plug an equal volume of air enters, and is almost certain to carry active nuclei with it. The process adopted by me is to boil a solution of 1, 2, or 3 parts of Glauber's salt to 1 part of water in a large flask, and to filter the boiling solution into 6, 8, or 10 five or six ounce flasks (each flask receiving two or three ounces of the solution), and then, covering each with a watch glass, to leave the flasks until cold, or until the next day. If the solutions had previously been operated on with fixed oils, the flasks, although cleaned for fresh trials, may not be so clean but that strong solutions in cooling crystallise. This may in general be prevented by re-boiling the solution for a few seconds after it has been filtered into the small flasks. In making an experiment, thin fluids, such as ether, benzol, &c., may be taken up in a clean straight dropping tube, fatty oils on a clean glass rod, and the watch glass being gently removed, a drop of the liquid is to be deposited on the surface, the tube or rod to be slowly withdrawn, and the watch glass replaced. In shaking a flask, the watch glass is to be held down firmly with the finger or thumb of the hand that grasps the neck.

Sodic sulphate is the best salt for the class of experiments indicated, but I have obtained good results with supersaturated solutions of potash and of ammonia alum, of sodic acetate, and magnesia sulphate. The films which spread on the solutions of alum produce very fine results of crystallisation.

Highgate, N., August 19th, 1870.

PRELIMINARY NOTICE ON THE

NITRO-SUBSTITUTION COMPOUNDS OF THE ORCINS.

By J. STENHOUSE, LL.D., F.R.S., &c.

MANY attempts have been made to prepare a nitro-compound from orcin, but hitherto without success—the orcin being converted, by strong nitric acid at ordinary temperatures, into resinous uncrystallisable compounds. When, however, colourless orcin in fine powder is gradually added to strong nitric acid cooled by a freezing mixture, it dissolves, with a pale brown colouration, but without the slightest evolution of nitrous fumes. If this solution be now slowly dropped into concentrated sulphuric acid cooled to a low temperature, the mixture becomes yellow and pasty, from the formation of the nitro-orcin, which is but slightly soluble in sulphuric acid. This is now poured into a considerable quantity of cold water, when the nitro body separates as a bright yellow crystalline powder, without any admixture of resin. One or two crystallisations from boiling-water suffice to render it quite pure. It is thus obtained in large yellow needles, which are soluble in alcohol, slightly soluble in cold water, but readily in hot. On analysis, it was found to have the composition corresponding to the formula—

$$C_7H_5(NO_2)_3O_2,$$

that of trinitro-orcin. It is a powerful acid, much resembling picric acid, but distinguished from the latter by the solubility of its salts; I therefore propose to call this new substance *trinitro-orcinic acid.*

Trinitro-orcinate of Potassium.—This is readily prepared from trinitro-orcinic acid, by dissolving it in a warm and rather concentrated solution of potassic carbonate. On cooling, it solidifies to a crystalline mass of fine needles

* *Proc. Roy. Soc.*, June 16th, 1870, pp. 535, 536.

of a deep orange colour. The salt, dried at 100° C., has the composition—

$$C_7H_3(NO_2)_3\left\{\begin{matrix}\\K_2\end{matrix}\right\}O_2.$$

The sodium-, calcium-, and silver-salts of this acid all crystallise well, and are tolerably soluble in water; the lead-salt is much less soluble.

Trinitro-resorcinic Acid.—Resorcin, prepared from galbanum by the excellent method given by its discoverers, Hlasiwitz and Barth, was treated with nitric and sulphuric acids, in precisely the same manner as that above described for orcin, and with similar results. Trinitro-resorcinic acid, when pure, crystallises readily, but is of a much paler colour than trinitro-orcinic acid, which it closely resembles in most of its properties. Analyses of the substance showed its composition to be $C_6H_3(NO_2)_3O_2$. It readily forms crystalline salts.

Trinitro-betaorcinic Acid.—Betaorcin, $C_8H_{10}O_2$, when treated with nitric and sulphuric acids as above described, gives a yellow substance, which appears to be the corresponding nitro compound of betaorcin; but, from the small amount of material at my disposal, I am at present unable to accurately determine its properties.

From some experiments I have made, the action of reducing agents, nitrous acid, &c., upon the nitro- compounds promise very interesting results; these, together with the preceding compounds, I am at present investigating.

The Laboratory, Rodney Street, Pentonville,
August 23rd, 1870.

EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.*

By FRANK H. STORER,
Professor in Massachusetts Institute of Technology.

(Continued from p. 90).

EXPERIMENT II.—*Determination of Water and Sulphuric Acid in Gypsum.*

To estimate the water, weigh out about 7 grms. of the finely-powdered mineral in a porcelain crucible of known weight. Heat the crucible over a Bunsen burner, at first gently, but afterward strongly. Allow the crucible to cool, and weigh it with its contents; again heat, cool, and weigh, and repeat these operations until the weight remains constant. Half an hour will be time enough for the whole work. The total loss of weight represents the water which the mineral contained. In our experiment 7·043 grms. of transparent crystallised gypsum *(selenite)* lost 1·48 grms.

7·043 : 1·48 = 100 : 21·01 per cent.

For the formula $CaSO_4+2H_2O$, theory requires 20·93 per cent of water.

To determine the sulphuric acid, transfer the ignited mineral in which the water has been determined from the crucible to a beaker of 600 or 700 c.c. capacity, pour upon it 100 c.c. of dilute chlorhydric acid (free from sulphuric acid), prepared by mixing 2 parts of water with 1 part of the strong acid. Heat the mixture twenty or thirty minutes, or until the gypsum has all disappeared. Pour in water enough to half fill the beaker, heat the solution nearly to boiling, and add to it a solution of chloride of barium, little by little, as long as any precipitate continues to fall. Stir the liquid continually with a glass rod while adding the chloride of barium, and during the subsequent heating, in order that no "bumping" may occur. After enough chloride of barium has been added, keep the liquor hot for five or ten minutes, then set it aside for ten or twelve hours in a moderately warm place, in order that the particles of sulphate of barium may subside, and become somewhat compacted and coherent.

Pour the clear supernatant liquor upon a six-inch filter, wash the precipitate in the beaker by decantation, first with boiling water, then with a boiling solution of acetate of ammonium (to decompose and remove any chloride of barium which may have been dragged down in combination with the sulphate), and, finally, three or four times with boiling water. Then transfer the precipitate from the beaker to the filter, pour hot water upon it until all the chloride of calcium has been removed, so that a drop of the filtrate, carefully evaporated to dryness upon a slip of glass, leaves no residue. Dry, ignite, and weigh, as in the preceding experiment.

$$\begin{matrix}\text{Molec. wt.}\\ \text{of } BaO,SO_3\end{matrix} : \begin{matrix}\text{Molec. wt.}\\ \text{of } SO_3\end{matrix} = \begin{matrix}\text{The wt. of}\\ BaO.SO_3\\ \text{found}\end{matrix} : \begin{matrix}\text{Wt. of}\\ SO_3\\ \text{therein.}\end{matrix}$$

From the aforesaid 7·043 grms. of mineral, there was obtained 9·5545 grms. of BaO,SO_3 (= 3·28 grms. SO_3).

7·043 : 3·28 = 100 : 46·57 per cent.

Theory requires 46·51 per cent.

The percentage amount of oxide of calcium contained in the mineral was estimated "by the difference." 100 − (21·01 + 46·57) = 32·42. Theory requires 32·56. The result of the analysis may be tabulated as follows:—

	Found.	Theory.
CaO (by difference) ..	32·42	32·56
SO_3	46·57	46·51
$2H_2O$	21·01	20·93
	100·00	100·00

(To be continued.)

ON THE

PREPARATION OF SPECIMENS OF SOUNDINGS FOR THE MICROSCOPE.*

By Professor A. M. EDWARDS.

IN the course of his gatherings it not unfrequently happens that the microscopist acquires specimens of the bottom of the ocean, from various localities, which, if properly prepared, furnish him with many beautiful objects for observation and study. And the beauty of these objects, the remains of once-living organisms, are of such a marked character and present so many points for admiration that, even to the unscientific observer, they become sources of pleasure often leading to farther enquiry into their life-history, so that imperceptibly almost, and by gradual degrees, the possessor becomes a student, in fact, and is induced to follow up his investigations to some practical end.

At the present time such specimens are of special interest, on account of the remarkable revelations made by the deep-sea dredging, lately carried on upon our coast and in Europe, and the bearing of these specimens upon Geology, Zoology, as well as other branches of science. The immense tracts covered by what Dr. Carpenter has characteristically termed "Globigerina-mud," on account of it teeming with *Foraminifera* so called and the connection of Prof. Huxley's "Coccoliths and Coccospheres," with the formation of the chalk-beds of the Cretaceous, open up to the microscopists an universe of new facts for investigation. Added to these calcareous organisms, the specimens of sea-bottom presents us with siliceous forms, both animal and vegetable, of surprising delicacy and beauty of outline and structure, and it was to these last named that my attention has been more particularly turned.

* Communicated by the Author. From the *Massachusetts Teacher.*

* From the *Proceedings of the Lyceum of Natural History, New York.*

Among such specimens of sea-bottom, the soundings taken at different times, and at various points on the coast of the United States by the Coast Survey, have been subjects of extreme value to the scientific observer, while they have, at the same time, furnished many unscientific possessors of microscopes with matter for admiration, wonderment, and joy; the graceful *Diatomaceæ*, the symmetrical *Radiolaria*, and marvellous *Foraminifera*, often present in such profusion, serving to enable the preparer to put up slides of surpassing beauty.

One of these soundings, for which I am indebted to the Smithsonian Institution, was of such a character that I was extremely desirous of studying as completely as possible the forms presented in it, belonging, as they did, to all of the three families mentioned, besides which it contained several minute mollusca and the remains of sponges and other organisms. It was, as shown by the remains present, of such a character as to consist essentially of calcium carbonate, commonly known as carbonate of lime, and silicon dioxide (silica), built up into the skeletons of dead organisms. The problem, then, presented to me, was to prepare it in such a way, if possible, first, to show all of these objects at the same time, or, second, to separate it into calcareous and siliceous specimens, and this last method I found, after trial, to be the best. As my mode of manipulation may hereafter be of value to others possessing similar gatherings, I will give it in detail.

The sounding, being in the shape of a dry powder of a light greyish-green colour, was placed in a suitable glass vessel and moderately strong liquor potassa poured upon it. It was now boiled for a few moments, until I saw that the lumps present in it were broken up, and a light mud-like sediment was the result. The solution of potassa must be, of course, apportioned in strength to the specimen under manipulation; such as consists of many lumps and much organic matter will require it of greater strength than that which is mostly calcareous and siliceous. If it be used too strong, some of the more delicate siliceous forms will be attacked, or even, as I have occasionally found, entirely dissolved. After it had boiled for a short time, as I have said, I allowed it to stand until the mud had settled, and a tolerably clear solution was left above it. I now poured off most of the liquor potassa, and replaced it by a strong solution of choride of soda, so-called. That sold by apothecaries under the name of "Labarraque's solution" will answer generally, and is readily procured. This I now boiled until I found its action to cease. By this means the mud is so much bleached as to become almost white. The potassa, at first, has the effect of dissolving much of the organic matter present, and thus breaking up the lumps and setting the shells free, and the chloride of soda solution bleaches them, so that we have them clean and separated to such an extent that, under the microscope, the individual shells are easily recognised. I now proceeded to separate the larger from the smaller forms by means of the "elutriation" process, which consists in first washing off thoroughly all the potassa and chloride of soda with pure filtered or distilled water, and shaking up the sediment in a glass about two inches high filled also with water. If now permitted to stand for a few seconds, the larger forms and coarser sand settles, and the supernatant liquid can be poured off into another larger vessel. Again, water is added to the first sediment, and, in turn, removed, and this is done as many as six or eight times, until we see that the coarse sediment is not contaminated by finer particles by the water it is shaken in remaining almost clear. The same process is carried out with the sediment in the second vessel, only permitting each charge of water to stand longer than in the first case, as the forms are now much smaller and require longer to settle. In this way we may get three or four densities of sediment, although I found that my specimen yielded but two which contained anything of interest of a calcareous nature. After, then, setting aside the two first sediments, I carefully acted upon what was left with hydrogen nitrate (nitric acid), and procured a small quantity of a sediment, consisting, for the most part, of nothing but the siliceous lorica of *Diatomaceæ*. They were very few, however; so, to procure all the remains of *Diatomaceæ* and other siliceous organisms present in the gathering, I took a quantity in the rough state, and, after breaking it down by potassa, acted on it with boiling hydrogen nitrate. Thus I found that I had good representatives of all the gathering contained. Some specimens, however, are not thoroughly cleaned by boiling, even for a considerable length of time in strong hydrogen nitrate. To such I add either hydrogen chloride alone or a few grains of finely-pulverised potassium dichromate. In this way, and after thoroughly washing with pure water, I have been enabled to obtain extremely beautiful specimens of *Diatomaceæ*, *Radiolaria*, and other siliceous organisms in a good condition for studying them. This I am engaged upon at the present time, and intend, before long, to lay the results before the Lyceum.

ON THE ANILINE OR COAL-TAR COLOURS.*

By W. H. PERKIN, F.R.S.

(Concluded from p. 93.)

I have in these lectures brought before you, in a rapid—I fear too rapid—manner, an account of most of the coal-tar colours; but, before concluding, I should like to show you the close relationship which exists between some of them, especially between those derived from rosaniline or magenta.

I have endeavoured to show you that the derivatives of magenta closely agree in properties, all of them containing colourless organic bases, the colour being developed upon their combining with acids. But I now wish to show you more than this, by briefly explaining their chemical structure. To describe this thoroughly, it would be necessary for me to enter fully into the chemical theory of substitution; but, as this would occupy a great deal of time, I must content myself with just mentioning a few facts connected with that subject.

Rosaniline and its derivatives contain carbon, hydrogen, and nitrogen, as I have told you on a previous occasion. Chemical substances containing hydrogen often hold it in what is termed a replaceable condition—that is, in such a condition that it may easily be removed—and another substance of equal value (either simple or compound) introduced in its place. A compound substance capable of replacing hydrogen is called a "radical"; and I want to speak about two of these radicals, one called ethyl, and contained in iodide of ethyl, the other called phenyl, and contained in aniline.

Ethyl contains C_2H_5.
Phenyl ,, C_6H_5.

I will first mention a familiar instance of the replacement of hydrogen by a radical. Water is composed of two equivalents of hydrogen and one of oxygen, thus—

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O.$$

Now, it is quite easy to remove an equivalent of this hydrogen and replace it by ethyl.

$$\left.\begin{matrix}H\\(C_2H_5)\end{matrix}\right\}O.$$

This is water with hydrogen replaced by ethyl, a replacement compound by some very much preferred to water itself; it is alcohol.

* The Cantor lectures, delivered before the Society of Arts.

Rosaniline contains three equivalents of hydrogen, replaceable by radicals. This is the formula of the hydrochlorate of rosaniline, the three separate H's being replaceable :—

$$\left.\begin{matrix}(C_{20}H_{16})\\ H\\ H\\ H\end{matrix}\right\}N_3,HCl.$$

Now, what takes place upon boiling this salt with aniline? The phenyl of the aniline simply takes the place of the replaceable hydrogen, producing what is called triphenyl-rosaniline. The result of this replacement is that the rosaniline salt has been changed from red into blue—the bleu de Lyon—which is represented thus :—

$$\left.\begin{matrix}(C_{20}H_{16})\\ (C_6H_5)\\ (C_6H_5)\\ (C_6H_5)\end{matrix}\right\}N_3,HCl.$$

Dr. Hofmann, on observing this relationship, was induced to try whether he could replace the hydrogen in rosaniline by other radicals than phenyl. He tried to introduce ethyl by digesting rosaniline with iodide of ethyl, and succeeded in introducing three molecules of the radical ethyl in the place of the three replaceable hydrogens. I will endeavour to show you how this takes place, by the following equation :—

$$\underbrace{\left.\begin{matrix}(C_2H_5)I\\ (C_2H_5)I\\ (C_2H_5)I\end{matrix}\right\}}_{\text{Three molecules of iodide of ethyl.}} + \underbrace{\left\{\begin{matrix}(C_{20}H_{16})\\ H\\ H\\ H\end{matrix}\right\}N_3,HCl.}_{\text{Hydrochlorate of rosaniline.}} =$$

$$\underbrace{\left\{\begin{matrix}HI\\ HI\\ HI\end{matrix}\right\}}_{\text{Three of iodide of hydrogen or hydriodic acid.}} + \underbrace{\left\{\begin{matrix}(C_{20}H_{16})\\ (C_2H_5)\\ (C_2H_5)\\ (C_2H_5)\end{matrix}\right\}N_3,HCl.}_{\text{Hydrochlorate of triethyl-rosaniline.}}$$

Here we see the iodine has simply exchanged its ethyl for the replaceable hydrogen of rosaniline, and the result is a blue shade of the Hofmann violet.

Now it is not necessary to replace the three hydrogens; two may be replaced, and we get a less blue violet, represented thus

$$\underbrace{\left.\begin{matrix}(C_{20}H_{16})\\ (C_2H_5)\\ (C_2H_5)\\ H\end{matrix}\right\}N_3,HCl.}_{\text{Hydrochlorate of diethyl-rosaniline.}}$$

Or, one may be replaced, and we get a red-violet, represented thus—

$$\underbrace{\left.\begin{matrix}(C_{20}H_{16})\\ (C_2H_5)\\ H\\ H\end{matrix}\right\}N_3,HCl.}_{\text{Hydrochlorate of ethyl-rosaniline.}}$$

When speaking of the violet imperial, I mentioned that it consisted of products intermediate between rosaniline and the bleu de Lyon. These intermediate substances consist of rosaniline with one or two equivalents of hydrogen replaced by phenyl.

Up to the present moment, it has only been found possible to replace one equivalent of hydrogen in mauveine, or the mauve dye; and, as I previously mentioned, it is curious that the result of this replacement is perfectly opposite to that which takes place in the case of rosaniline, the replacement of hydrogen by ethyl in rosaniline causing it to become bluer in shade, and the replacement of hydrogen by ethyl in mauveine causing it to become redder in shade. The following is the formula of the hydrochlorate of ethyl-mauveine or dahlia :—

$$\left.\begin{matrix}C_{27}H_{23}\\ (C_2H_5)\end{matrix}\right\}N_4HCl.$$

But, although I have tried to explain the relationship of these colouring matters as simply as I can, yet this part of my lecture assumes much of the character of a lecture on theoretical chemistry. Here we are talking about substitution products of bodies, a branch of the highest theoretical chemistry, and it must strike us as remarkable, when we find that these considerations have been pressed upon us by the discussion of bodies which may now be said to be common dye-stuffs. We have also been talking quite in a familiar manner about nitrobenzol, aniline, iodide of ethyl, aldehyde, &c., substances which were, only a few years since, the *recherché* compounds of the laboratory. In fact, the coal-tar colour industry is entirely the fruit of theoretical chemistry. Let us consider the enormous rapidity with which this industry has developed. It only dates from 1856, and now we have large factories for the production of coal-tar colours, not only in Great Britain, but in Germany, France, Switzerland, America, and other countries. I had hoped to have been able to give you a statistical account of this industry, but have not had sufficient time for this purpose. Dr. Hofmann, however, in his report on the coal-tar colours shown at the Paris Exhibition of 1867, remarks that, "in 1862, the value of these manufactures had risen from nothing to 10,000,000 of francs, or more than £400,000 sterling. At the present day this sum is trebled, which would make it about one million and a quarter pounds sterling, although the products are much cheaper than they were before." And now, when you hear of these results, do not forget that they are the truly practical fruits of theoretical chemistry, not studied for the purpose of producing commercial products, but simply for its own sake.

THE DETERMINATION OF COMBINED CARBON IN IRON AND STEEL BY THE COLORIMETRIC PROCESS.*

By J. BLODGET BRITTON,
Of the Iron-Masters' Laboratory.

LONG ago Professor Eggertz, of Fahlun, Sweden, called the attention of metallurgical chemists to the fact that when pure metallic iron is dissolved in nitric acid, of common strength, the solution, if not too concentrated, is colourless, or nearly so; but when steel, or iron containing carbon in combination, is substituted for the pure metal, the solution is coloured, and the shade varies exactly in proportion to the amount of carbon present; and, based upon this fact, he suggested a method whereby carbon determinations, sufficiently accurate for many commercial purposes, could be made with facility.

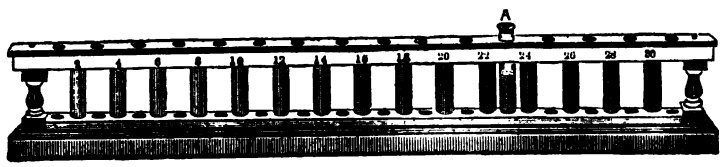
Several modifications of this method have been proposed. One of them, affording exceedingly accurate results, has been in use at the Iron-Masters' Laboratory for some time. Instead of a single tube, containing a standard solution for comparison, as suggested by Eggertz, a number of tubes having their solutions differently standardised, one from the other, are employed. These are arranged securely in a walnut-wood frame, with spaces between for placing the tube containing the solution to be tested, and forming together a convenient portable instrument called a colorimeter—an exact representation of such an instrument is here annexed. The position of the tube containing the solution to be tested is shown at A.

* Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute.*

The tubes are ½ths of an inch in diameter, and 3½ inches in length, filled with water and alcohol coloured with roasted coffee, and hermetically sealed. The solution in the tube to the left has its colour to correspond exactly with one produced by 1 grm. of iron, containing 0·02 per cent of combined carbon, dissolved in 15 c.c. of nitric acid. The solution in the tube next to it has its colour to correspond with one produced by the same quantity of iron, but containing 0·04 per cent of combined carbon, and so with each of the other tubes, increasing 0·02 per cent of carbon in regular succession to the right, the last reaching 0·3 per cent as indicated by the figures on the upper rail of the instrument.

On the back of the instrument, and for the purpose of partially screening the light and allowing the different shades of colour to be distinctly discerned, there is tightly stretched between the rails some fine white parchment paper. This screen is not shown by the cut, but it serves a very important purpose.

The process is conducted as follows:—1 grm. of the finely divided metal is put into a tube of about 1½ inches in diameter and 10 inches long, and digested for fifteen or twenty minutes in 10 c.c. of nitric acid of a little more than 1·20 sp. gr. free from chlorine. The solution is then cautiously poured into a beaker, and a small portion of metal which remains undissolved and adheres to the bottom of the tube, is treated with 5 c.c. of fresh acid and exposed to a gentle heat till completely dissolved and added to the other. The contents of the beaker, when sufficiently cool, are filtered through two thicknesses of German paper (not previously moistened and of a diameter not exceeding 4½ inches) into a tube about 5 inches long



and of precisely the same diameter as those in the instrument.

After the filtered solution has remained for some minutes, at the temperature of the atmosphere, and its colour become fixed, the tube is placed in the instrument and the carbon determined by a comparison of shades;—the determination may be made readily as close as 0·01 per cent.

Heat should not be applied in the first instance to facilitate the solution of the metal, because a high temperature is apt to cause a slight loss of colour. Two thicknesses of paper are taken because one alone is liable to break; and the paper should be used dry, for, if previously wetted, the water will weaken the colour of the solution, and it ought to be cut to a size not exceeding 4½ inches to prevent undue absorption.

If the metal to be examined contains more than 30 per cent of carbon, 0·5 grm. or less of it, may be taken, or the solution may be diluted with an equal volume or more of water and the proper allowance made; or an instrument of higher range may be used. On the other hand, if the metal contains a very small per cent of carbon, 2 grms. of it may be taken. For preparing the standard solutions (the normal ones begin to lose colour after some hours), caramel dissolved in equal parts of water and alcohol, as suggested by Eggertz, answers well; but with roasted coffee as the colouring matter I have succeeded in obtaining the true shades. I must say, however, that this latter solution has not been in use sufficiently long to allow me to positively assert that its colour will not change after some length of time. As a rule, the instruments are kept in the dark, except when in actual use, and no perceptible change has yet taken place.

ON THE TEMPERATURE AND HEATING-POWERS OF FLAMES.

By Professor H. WURTZ.

In the CHEMICAL NEWS of June 24, there is a communication (said to be copied from the *Philosophical Magazine*, which latter I have not yet seen), with criticisms by W. M. Watts, D.Sc., upon the paper of Professor Silliman and myself on the "Calorific Powers or Effects of Gases," read to the American Association at Salem in August of last year, as forming the *introductory part* of a pending investigation on the important practical subject of the temperatures of the flames of such gases as are ordinarily employed for heating and lighting purposes. This paper was published in the previous issue of the CHEMICAL NEWS.

Mr. Watts accuses us, first, of "confusion" between heating-powers and flame-temperatures, not observing that this introductory paper is confined to heating-powers or effects, the subject of temperatures being left to future occasions; hence he betrays inattention to our paper, if not confusion of ideas on his own part, when he suggests to us, in a note, that in our first conclusion on the heating *effect* of carbonic oxide, we really mean the "flame-temperature" thereof. Such a change in our wording would be confusion indeed. The temperature of an open flame is usually highly variable in various parts, and we have applied the term "flame-temperature" to that of the hottest zone only. I believe that to any attentive reader, not anxious to pick flaws, our meaning in the use of the term maximum *calorific effect* must be manifest; namely, the total and final amount of heat (so to speak) or heating result, after total combustion, without regard to *time* or rapidity of combustion, of which, of course, the temperature is a function.

Mr. Watts's reasoning against our result as to the heating effect (*called by him flame-temperature*) of olefiant gas being lower than that of carbonic oxide, especially compels me to think that he has not read our paper with that attention which so confident a criticism should imply. This reasoning may apply, partially at least, to the case of the combustion of these two gases with the necessary amount of *pure oxygen*, being then essentially a re-statement (though not complete) of the conditions of the actual experiments of Favre and Silbermann, but is wide of any application to our own case, in which the *nitrogen of the air* plays a large part. In burning in the air, as a simple calculation shows, one volume of CO has to heat but two volumes of N and half a volume of O, whereas one volume of olefiant has to heat more than 11 (exactly 11·29) volumes of N and three volumes of O, or 14·29 volumes altogether, up to the temperature of its flame, or of the body heated thereby. Thus in the case of aërial combustion, the total heat of the olefiant volume is distributed or *divided* throughout 5·72 times greater bulk of air than is the case with carbonic oxide. Hence (in part) the lower calorific effect of olefiant in air, even when the latent heat of the steam of combustion is recovered by condensation. Of these, with other things, Mr. Watts takes no heed, and, in view thereof, I think that we can justly retort his accusation of "confusion."

As to the correction necessary in Bunsen's gasometry, for the heat of the steam of combustion of hydrogen, we were informed that this had been made, but not by whom. Our informant, Professor Cooke, of Cambridge, thought by Bunsen himself, but we were unable to verify this, and in a note to our paper, as published in the *American Journal of Science* (p. 342) referred to the subject somewhat doubtfully. Our thanks are therefore due to Mr. Watts for the reference to Dibbits.

The exception made by Mr. Watts to the formula

for the total calorific of hydrogen relating to the correction for the difference between the specific heats of water and steam, is one which I cannot at present individually enter upon, and to which I shall again return. I will merely say that there has been controversy upon the points here involved; mentioning, also, that the number calculated by Deville, for the total calorific power of hydrogen in oxygen is 6800°, which is about the mean between Mr. Watts, and the figure adopted by us (See *Revue des Cours Scientifiques*, March 13th, 1869, p. 232).

As to the comments made on our conclusion regarding carbonic oxide, that "of all known gases" it gives the highest calorific effects, I am quite ready to confess that Mr. Watts has convicted us of a lack of precision of language which we ought to have avoided. We may, however, plead in mitigation, that our paper was more especially intended to introduce the subject to *practical men*, in available forms; and that we, therefore, with an inadvertence not wholly excusable, held in mind only such gases as are met with appreciably in practice. Mr. Watts therefore puts us again under obligation here.

Some readers will doubtless conclude, from Mr. Watts's last paragraph, that he suspects Professor Silliman and myself of ignorance regarding the experiments of Bunsen and Deville on the actual temperatures of the flames of hydrogen and carbonic oxide. The readers of this journal will not heed such an insinuation, in view of discussions by the present writer, of the researches of these two chemists, that have appeared in these columns, antedating the presentation of the joint Salem paper. (See particularly *American Gas-Light Journal* of August 2nd, 1869, p. 34.) One sentence in that paper might, I should think, have presented such an impression on the part of Mr. Watts. This is where we say that our figure 6851° C. "is the temperature actually possible in the flame of the compound blow-pipe *were the combustion instantaneous and complete*" (the italics being in the original). The subject belonging, however, to that of flame-temperatures, which we had not as yet strictly entered upon, was deferred by us for the time being.

Finally, I cannot but submit that Mr. Watts in presenting his concluding table, has in several ways inadvertently laid himself open to criticism of a class similar to most of that applied to us, including the accusation of confusion of ideas and terms. I shall be satisfied with respectfully presenting two questions. If the second column comprises the actual flame-temperatures, as determined by experiment, why does he designate the first column also "flame-temperatures"? Are not these latter figures precisely what *we* have designated as total *calorific powers* or *effects*, instead of temperatures?

ON THE

EFFECTS OF THE APPLICATION OF THE HOT BLAST TO BLOWPIPE PURPOSES:

AND THE PROPOSED SUBSTITUTION OF HEATED AIR FOR OXYGEN IN THE PRODUCTION OF CERTAIN THERMAL AND ILLUMINATING EFFECTS.

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

THE useful and well-known effects of the hot blast, in the process of iron smelting, has induced me to try and extend it profitably to other purposes, beyond that which prompted its application in the present instance.

My experiments, as yet, have been confined to testing the effects of substituting a hot blast for a cold one, as hitherto used, for the production of the well-known blowpipe flame; a flame so produced will be expected to have its thermal and illuminating effects augmented, but scarcely, perhaps, to that degree which experiment has demonstrated.

I had better state, at the outset, those particulars which it is necessary to know, before relating the results.

The temperature of the blast was, approximately, 500° F.; the diameter of the jet, regulating its issue, was 1-30th of an inch; the combustible for receiving the blast was stearine.

This flame manifested a very marked superiority over the common blowpipe flame—substances difficult to fuse in the latter, magnetite, potash-felspar, mica, readily yielded under these circumstances; while thick glass tubes, half an inch in diameter, and hard German glass tubes, were tractable to an eminent degree.

Carrying my test experiments still further, I found several substances, for the fusion of which the oxyhydrogen flame, or some equivalent of it in heating power, is said to be indispensable, also yielded before the blowpipe-flame thus urged: for instance, platinum, pipe-clay, fire-clay, agate, opal, flint.

Several samples of each were tried, and always with the same results; it could not well be, therefore, that the fusibility of any of these substances was due to the accidental presence of foreign matter, in more than usual quantity.

The platinum was the common platinum foil, also a sample prepared especially for the purpose; the only impurity found in it was iron, as traces, communicated to it in the act of forging; possibly minute quantities of some of the other metals of the platinum series might be present, but they would rather tend to increase its infusibility than otherwise.

Alumina only appeared to vitrify; while, after numerous trials with crystallised quartz, I could not succeed in fusing it to a globule; thin splinters, however, curled round upon themselves, like scolezite, and ultimately assumed a glazed appearance, clearly showing that the melting-point was all but reached.

It appears, from this, that a very small amount of some foreign substances exercises a marked effect upon the fusibility of silica, agate, opal, &c., being only a little less pure than rock crystal, though so readily fusible in this flame.

Regarding the illuminating power of the flame so produced, when allowed to impinge upon a solid substance, such as lime or magnesia, it was not only more intense (as would be expected), but the volume of incandescent matter was largely increased.

Before I proceed to urge the further use of hot air for combustions, where high temperatures are necessary, I wish to call attention to the fact, that the temperature of the flame, which I have hitherto worked with, can be largely and economically increased by increasing that of the blast; this can easily be done to a threefold extent.

By substituting heated hydrogen (or burnt coal-gas), I have also realised all the effects just instanced, with greater rapidity and decision; but the great diffusiveness of this gas, especially when heated, has prevented me, as yet, carrying the experiments further.

While on the subject of heating both combustibles (at least, both the substances which take part in these combustions), I cannot refrain from remarking how easily the temperature of the oxyhydrogen flame, even, could be increased in this manner—the gases would, of course, have to be heated prior to contact. Upon their more vigorous diffusiveness, when rarefied, I should rely for that solidity of flame so necessary where the communication of very high temperature is desired. The jets regulating the issue of the gases would have to be very fine.

Proceeding now to the next part of this subject: the result of these experiments, instanced, urge me to recommend, for trial, the substitution of heated air for oxygen, in most of those cases where this gas is now employed in conjunction with hydrogen, or other combustible matter, as a generator of heat or light: for instance—

1. In the metallurgy of platinum, that part of it where the metal has to be fused; also in soldering platinum stills for sulphuric acid works.

2. The fusion of alumina in the manufacture of certain gems.

3. In the production of the Drummond and Bude lights.

The fusion of platinum and alumina is now effected by the oxyhydrogen flame.

Relative to the competency of heated air to perform the part of cold oxygen in the production of such intense lights as these (the Drummond and the Bude), I think this can be demonstrated, almost to a certainty, in the following way:—

Thus—the flame employed in these investigations has certainly a minimum temperature of 4596° F., since this is the fusing point of platinum, the substance most easily fused of all those I have tried that are infusible in the common flame; doubtless the temperature is considerably higher, but I will take these figures. On the other hand, the actual temperature of the lime, when the Drummond light is in operation, is (on the authority of Tyndall) only 2000° C. = 3632° F.; hence this flame has an excess of temperature over that of the incandescent lime equal to 964° F., a pretty good margin for loss, surely sufficient if properly economised; but as I have already shown, this excess of temperature can be largely increased.

In view of the greater controllability of the proposed substitute, the absence of all danger in its use, its not requiring chemical preparation, and its cheapness, compared with oxygen; upon these several points, respectively, the question should be properly tested.

Besides the substitution of oxygen urged above, the possible fusion of the purer clays, and certain silicas, &c., in a ready and economical manner, may induce the further utilisation of these substances, while, in experimental chemistry, the facility with which such high temperatures can be attained and kept up may lead, among other things, to some cheaper way of extracting certain metals from their oxides—aluminium, for instance, from alumina or clay.

On reviewing these results, it does seem not a little singular that a difference of not more than 500° F. in the temperature of the blast should make the difference between the fusibility and infusibility, of such substances as platina, agate, fire-clay, &c., in the blowpipe flame. It will be recollected, however, that the blast has, in this case, not only taken up the heat required to raise a single volume of it to this temperature, but another portion of heat has been taken up in a latent form, as the air expanded, —consumed as it were in lifting against the atmospheric pressure; this may be represented sufficiently well for us, by assuming the temperature of the blast, kept to its normal volume, at 700° F.

This is as yet, however, but a very slight addition to produce results, which so nearly approximate to those obtainable by the oxyhydrogen flame, seeing the latter has an estimated temperature of 14,000 to 15,000° F., while that of the present method does not much exceed 5000° F. The gap, as far as effects is concerned, is narrowed so much, and in a manner so unexpected, by the results here given, that one is naturally prompted to enquire whether the assigned temperature of the oxyhydrogen flame has been obtained by direct experiment, or by calculations, based upon the ascertained temperature of other flames. The temperature as calculated, indirectly, in this last way, certainly furnishes us with figures remarkably close to those just quoted.

In reference to this important point I beg to call attention to a notice, which appeared in the Chemical News, relative to the imperfect combustion of certain gases at high temperatures.

There we learn that at moderately high temperatures (much below 10,000° F.) oxygen and hydrogen only very partially combine,—from memory, I believe, not more than to the extent of half their weight,—the remainder of the gases of course combine, as the centre of heat is left behind. Thus, although the quantity of heat evolved by their combustion is the same, being divided over a larger volume, its intensity is proportionately diminished.

This being so, it would seem to follow that the temperature of the oxyhydrogen flame must be very considerably lower than that hitherto ascribed to it; and, therefore, the possibility of substituting it in this, or in some other manner equally economical, for the several purposes here specified, appears so much the greater.

OBITUARY.

DR. P. BOLLEY.

We regret to learn that Dr. Bolley, the celebrated chemist and technologist, died suddenly on the 3rd inst. The deceased was born at Heidelberg, in 1812; received his preliminary and university education in his native town; and, in 1836, took the degree of Ph.D. For some time after that period, he was the first assistant of the late Professor Gmelin; in 1838, he was appointed Professor of Chemistry of the Cantonal School of Aargau (Switzerland); while, in 1843, he was elected Director of the Polytechnic School of that town. These positions he exchanged, in 1854, for his appointment of Professor of Chemistry and Technology at the Federal Polytechnic School, at Zurich, after having first become, in 1850, a naturalised Swiss citizen. From 1859 to 1866, Dr. Bolley was Director of this school, which difficult post he filled to the full satisfaction of the Swiss Federal Government, and, by his exertions, this institution became one of the most prosperous and most frequented of the Continent, the number of pupils having increased from 109 to 550, among whom were 314 foreigners from almost all parts of the world, including such remote countries as Chili, Peru, &c. In the years 1851 and 1862, the deceased was sent to London by the Swiss Federal Government to report upon the exhibitions; and, in 1867, he visited Paris for the same purpose. Dr. Bolley's published works are very numerous. He first started, and was for some time chief editor of, the *Schweizerische Gewerbeblatt* (from 1840, and continued to the present day); he was also one of the chief contributors to the *Schweizerische Polytechnische Zeitschrift*; and, in company with several eminent *savants*, he edited a most complete and valuable work on Chemical Technology, in the German language, of which work he had, just before his death, finished the section on Natural and Artificial Dyes and Pigments. Dr. Bolley also published a Manual of Technico-Chemical Research, which was originally issued in the German language, but has been translated into English and French. The deceased was highly respected in every way, and his sudden demise is a very great loss to the Helvetian Republic, of which he was an eminently useful and valued citizen. As might be expected, the deceased was a member of very many scientific societies in various countries. The Swiss Federal Polytechnic School above alluded to is an institution established at the expense of all the Swiss cantons, jointly, and under the chief management of a committee, elected from among the national council for a period of five consecutive years; the Director of the school is the chief executive of the establishment, under the aforesaid committee, among which generally scientific men of note are found as members. This school is arranged upon the plan of that adopted for the school alluded to in the Chemical News, vol. xxii., p. 58.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor Tyndall, LL.D., F.R.S.

(Continued from p. 68.)

Electric Polarisation: Ritter's Secondary Pile.

234. When an electric current is sent through acidulated water a film of oxygen covers the positive electrode, and a film of hydrogen covers the negative electrode. One of these two substances being electro-positive, and the other electro-negative, they act in the liquid like two different metals; the hydrogen plays the part of zinc, and the oxygen plays the part of platinum.

235. Interrupting the primary battery circuit, and uniting together the two plates covered with their respective films, an electric current is obtained.

236. The direction of this current is from the hydrogen film to the oxygen film in the liquid, and from the oxygen film to the hydrogen film through the connecting wire.

237. Two electrodes thus covered with condensed gaseous films are said to be *polarised:* and the currents obtained from them are called currents of polarisation.

238. Now the battery current being always from oxygen to hydrogen (see Note 211), it is plain that the current of polarisation is always opposite in direction to the battery current employed to polarise the electrodes.

239. When a decomposition cell with platinum plates is introduced into a voltaic circuit, it is found that the battery current, though strong at starting, gradually sinks. This sinking is due to the gradual development of the antagonistic current of polarisation.

240. Also in the cells of the battery itself this current of polarisation may come prejudicially into play. When two metals, say zinc and platinum, and one liquid, say acidulated water, are employed, the platinum plate is coated with a film of hydrogen.

241. This hydrogen, being electro-positive, resembles a plate of zinc, so that when it is present we have, as it were, zinc opposed to zinc in the battery.

242. Were both plates actually of zinc we could have no current; and with the hydrogen film which approximates to zinc we have only a feeble current. To get the full effect of the zinc and platinum some means must be devised to remove from the platinum its film of hydrogen.

243. This is effected in Grove's battery by the employment of *two liquids*. The one is strong nitric acid, which contains the plate of platinum; the other is dilute sulphuric acid, which contains the plate of zinc. The nitric acid is placed in a vessel of porous earthenware, which becomes saturated with the liquid and allows the current to pass through it.

244. When the current passes, the hydrogen liberated at the platinum electrode in Grove's cell is instantly oxidised by the nitric acid, and prevented from forming a film upon the surface of the platinum.

245. If instead of employing a single decomposition cell and a single pair of platinum electrodes, we employ a series of such cells, and send the same current through them all, we convert every pair of such plates into an active voltaic couple; and if the number of such couples be great, effects of great intensity may be obtained.

246. If instead of using decomposition cells we simply employ a series of plates of the same metal, say a series of half-crowns, separated from each other by pieces of bibulous paper or by bits of cloth wetted with acidulated water; on sending a voltaic current through such a pile of plates, we liberate on one of the surfaces of each plate a film of oxygen, and on the other surface a film of hydrogen. These play the part of the two different metals in the pile of Volta.

247. The electro-motive force of such a pile may be far greater than that of the battery which charges it. It may produce a far more brilliant spark, and urge its current against resistances which would be quite insuperable to the original battery current.

248. The discoverer of this form of pile was Ritter; it is sometimes called *the secondary pile*, to distinguish it from the battery which charges it.

Faraday's Electrolytic Law.

249. When the self-same current is sent through a series of cells containing various compound liquids, the same amount of liquid is not decomposed in all cases.

250. Let the current be sent in succession through a series of cells containing water, oxide of lead, chloride of lead, iodide of lead, and chloride of silver; then taking them in the above order, the weights of the liquids decomposed are represented by the numbers 9, 111·5, 139, 230·5, 143·5.

251. The question now is, how are these weights of the respective substances divided between the two electrodes? Supposing the numbers to express grains, we should have the following division between the electrodes:—

At the positive electrode. Grains.		At the negative electrode. Grains.
Water..	8·0 oxygen	.. 1·0 hydrogen.
Oxide of lead ..	8·0 ,,	.. 103·5 lead.
Chloride of lead .	35·5 chlorine	.. 103·5 ,,
Iodide of lead ..	127·0 iodine	.. 103·5 ,,
Chloride of silver	35·5 chlorine	.. 108·0 silver.

252. Now these numbers express the combining proportions of the respective substances; by the electric current in all cases the law of combination as regards quantity is exactly inverted. The substances combine in equivalent proportions; they are decomposed in precisely the same proportions. This is the celebrated law of electrolysis discovered by Faraday.

253. In no case in the body of the electrolyte is any decomposition observed; in no case is any gas there liberated. The substances set free appear at the electrodes, and there alone.

254. Taking water as an illustration, the process is to be figured thus:—When the electrodes, charged with electricity from the battery, are plunged into the liquid, the oxygen atom of the water turns towards the positive, and the hydrogen atom towards the negative electrode.

255. If the electro-motive force be strong enough, the oxygen is torn away from its hydrogen; the free hydrogen immediately converges its attraction on the next adjacent oxygen atom, and unites with it, dislodging at the same time the hydrogen with which that atom had been previously combined. Another atom of hydrogen is thus liberated, which in its turn decomposes the adjacent water molecule. Thus through the chain of molecules run a series of decompositions, followed by immediate recompositions, until the negative electrode is reached. Here the hydrogen, having no further oxygen with which to combine, is liberated as a gas. This is the theory of Grotthuss, which, at all events, fairly embraces the facts.

Nobili's Iris Rings.

256. The hardness of steel in tempering it is judged by its colour, which is due to a film of oxide overspreading the steel. The oxide which forms on the surface of molten lead also shows vivid colours.

257. These are the colours of *thin plates* investigated by Newton and explained by Thomas Young.

258. By electro-chemical decomposition Nobili produced such colours in a very beautiful manner. Placing, for example, a polished steel plate in a dilute solution of acetate of lead, and connecting the plate with the positive pole of a voltaic battery, on dipping the end of a wire connected with the negative pole into the solution, the peroxide of lead is liberated on the surface of the steel immediately under the wire; and a film gradually diminishing in thickness spreads from that point outwards.

Round this point we have a series of concentric circles showing vivid iris colours.

259. These colours, like all those of thin plates, depend upon the thickness of the film, which diminishes as the distance traversed by the current increases.

(Du Bois-Reymond has shown that when the point from the negative end of the battery is very near the steel plate, the thickness of the film corresponding to the different circles is inversely proportional to the cubes of their radii.)

Distribution of Heat in the Circuit.

260. When the two ends of a voltaic battery are connected by a thick wire of good conducting material the wire is not sensibly heated; the heat due to the oxidation of the zinc is in this case confined to the battery itself.

261. But if the two ends of the battery be connected by a wire that offers a resistance to the current, the wire is heated, and may, if properly chosen, be raised to a white heat.

262. Considering the battery as the hearth where the zinc is burnt, we might be led to infer that the heat due to the combustion of the zinc is liberated on the hearth itself, and that its amount depends solely upon the quantity of zinc consumed.

263. This, however, is not the case. Let the battery, with its two ends united by a thick wire, be surrounded by a vessel of water, to which the heat developed by the oxidation, say of an ounce of zinc, is communicated; the quantity of heat developed is measured by the rise of temperature of the water.

264. Let the battery, with its two ends united by the resisting wire, be placed in the same vessel, and let the heat generated in the battery by the oxidation of an ounce of zinc be again determined; this heat will be less than that observed in the last experiment.

265. If the connecting wire be now enclosed in a separate vessel, and if the heat generated in the wire be thus determined, on adding this amount of heat to that liberated in the battery, a total heat is obtained exactly equal to that generated in the battery alone, when the good conducting wire was employed.

266. In fact, the absolute amount of heat generated by the oxidation of an ounce of zinc is perfectly constant; but it may be distributed in various proportions between the battery and the external circuit.

Relation of Heat to Current and to Resistance.

267. On what does the heat developed in a wire uniting the two ends of a voltaic battery depend?

268. It depends, in the first place, on the strength of the current, but it is not simply proportional to that strength.

269. Let the strengths of a series of currents, determined either by the tangent-compass or the voltameter, be represented by the numbers 1, 2, 3, 4, then the quantities of heat developed in the same wire by these respective currents are expressed by the numbers 1, 4, 9, and 16.

270. The heat generated is therefore proportional to *the square* of the strength of the current.

271. Preserving the strength of the current constant, the heat generated is proportional to the electrical resistance of the wire through which it passes. These important principles were established by Joule.

272. Thus if one of two equal currents pass through a silver wire, and the other through a platinum wire of the same length and thickness, the heat generated in the platinum will be ten times that generated in the silver, because the resistance of the former is ten times that of the latter. To urge the current through the platinum in this case would, however, require greater battery power than that necessary for the silver.

273. Hence, when *the same current* is sent through a wire composed of alternate lengths of silver and platinum of equal thickness, the platinum spaces may be raised to a white heat, while the silver is not raised to the faintest glow.

(To be continued.)

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 16, 1870.

As may be expected, from various causes to which it is unnecessary to allude, this number is a very small one, the meeting of the Academy having only lasted about twenty minutes. The original papers and memoirs relating to physico-chemical and allied sciences are the following:—

Decimal Division of Angles and Time.—Y. Villarceau.—This lengthy paper contains a very concise review of the reasons in favour of the application (for scientific purposes, at least) of the decimal division of the objects alluded to.

Reply to the Note of M. Jamin published in the preceding number of this Periodical.—H. Sainte-Claire Deville.

The Sun.—Rev. Father A. Secchi, S.J.—The author, while passing through Paris, presents to the meeting his work on the above-named subject just published in the French language. This volume is divided into three parts; the first is devoted to the explanation of the modern means and methods of observation, and describes the structure of the sun; the second portion treats of the influence of the sun in the universe; while the third part describes the relations of the sun to the stars. The author states that he feels confident that this work contains everything relating to this subject which has been discovered and investigated by the various *savants* of the whole world who have devoted their labours to this matter.

Normal Amylic Alcohol.—A. Lieben and A. Rossi.—In order to prepare this new alcohol, the authors have first procured normal cyanide of butyl and the valeric acid corresponding thereto, which is isomeric with that produced by the oxidation of ordinary amylic alcohol. This new acid boils at 185°, and yields regularly-crystallised salts. The lime-salt of this new acid, having been mixed with formiate of lime, and submitted to dry distillation, produced an aldehyde which, on being hydrogenised, produced the new alcohol; this, in many of its properties, resembles the fermentation amylic alcohol, but differs therefrom by a higher boiling-point (137°). The authors have prepared, by well-known methods, the chloride, bromide, iodide, and acetate of amyl, all of which ethers differ from the ordinary amylic ethers by a higher boiling-point. The formula of this new amylic alcohol is—

$$\left.\begin{matrix}CH_2\\CH_2\\CH_2\\CH_2\\CH_2.OH\end{matrix}\right\} = \left\{\begin{matrix}CH_2.CH_2.CH_2.CH_2\\H\\H\\OH.\end{matrix}\right.$$

Experimental Researches on the Modifications of the Immediate Composition of Bones.—F. Papillon.—The author relates, at length, some experiments instituted with live animals, to which were given, among their food, phosphate of strontia, phosphate of alumina, and phosphate of magnesia. These experiments were continued for several months, and the animals (pigeons and rats) which did not seem to be in the least affected by partaking of the small daily doses of the mineral matters alluded to, were killed, and their bones submitted to analysis, with the following results:—Ash of bones of pigeon, in 100 parts—Lime, 46·75; strontian, 8·45; phosphoric acid, 41·80; phosphate of magnesia, 1·80; residue, 1·10—total, 99·80. Bones of a rat, in 100 parts—Alumina, 6·95; lime, 41·10. Bones of another rat (to which phosphate of magnesia had been given), in 100 parts—Magnesia, 3·56; lime, 46·15.

Bulletin Mensuel de la Société Chimique de Paris, July, 1870.

From the *procès verbaux* of the meetings of this Society held in May last, and published in this number, we quote the following:—

Researches on the Vapour Density of Perchloride of Phosphorus.—Dr. Wurtz.—It is a known fact, says the author, that, when this compound is brought to the state of vapour, it is dissociated into protochloride of phosphorus and chlorine, in such a manner that its vapour occupies 4 volumes instead of 2. The author, thinking that this dissociation might be greatly retarded by the presence of a large ex-

cess of one or other of the products of this dissociation, has taken the vapour density of perchloride of phosphorus, by causing its vapour to be diffused through the vapour of protochloride, and, by this means, has obtained results coinciding with those which theory indicates for 2 volumes of vapour. The experiments were made according to M. Dumas's method, by introducing, into a previously-weighed glass balloon, perfectly dry perchloride of phosphorus, with an excess of protochloride, and heating to from 166° to 190° in a paraffin bath. The theoretical vapour density (2 volumes) is 7·2; the results of the experiments alluded to vary from 6·25 to 7·42.

Action of Iodide of Cyanogen upon Oil of Turpentine.—MM. de Clermont and Schutzenberger.—When these substances act upon each other at 60°, there is formed an iodine-containing liquid and a syrupy nitrogenous substance. The former body yields, when treated with an alcoholic solution of caustic potassa, or with moist oxide of silver, a solid camphor-like substance. When a cold ethereal solution of iodide of cyanogen acts upon the oil of turpentine, a tarry substance is obtained, and an iodine-containing liquid, which, if distilled in vacuum, explodes at about 100°. When iodine acts upon oil of turpentine, it appears that identical bodies are produced. The authors continue these researches.

This number contains, further, the following original papers:—

Observations on the Critical Remarks made by M. Thomsen in reference to the Calorimetrical Methods of MM. Favre and Silbermann.—H. Sainte-Claire Deville.—This paper is written chiefly to prove that the mercurial calorimeter is a suitable and proper instrument for accurate experiments, if used according to the rules and indications given by M. Favre.

Solid Cresol.—A. Wurtz.—This paper contains the description of a process for obtaining the body alluded to, by treating hydrocarbons with sulphuric acid, and decomposing the conjugated sulpho-acids by potassa. The author states that he (as has been also observed by M. Barth, who has been experimenting on this subject) found that, during the reaction, some salicylic and paroxybenzoic acids are formed.

Some Compounds Homologous with Tartaric and Malic Acids.—H. Gal and J. Gay-Lussac.—This paper contains the following chapters:—Adipo-tartric, adipo-malic, subero-malic, and subero-tartric acids.

Action of Chlorhydric Acid upon Osseine; New Researches for the Estimation of Osseine in Fossil-Bones.—A. Scheurer-Kestner.—This paper is mainly a reproduction of the author's paper on this subject as published in the *Comptes Rendus*, and already abstracted therefrom by us.

Manufacture of Tam-Tams, or Gongs, and Cymbals.—A. Riche and P. Champion.—This paper contains an account of the method now followed for making the sound-producing instruments alluded to, which consist of an alloy of 80 parts of copper and 20 of tin, which is hammered out with frequent annealing. An alloy of 78 of copper and 22 of tin answers better, and can be rolled out. The process is similar to that in use in China, and is carried out at Paris by M. Cailar.

New Series of Platinum Compounds.—Dr. P. Schutzenberger.—This paper contains, at great length, all the particulars relating to a new series of platinum compounds discovered by the author, and already referred to by us from his paper in the *Comptes Rendus* on this subject.

Abstract of a Memoir on the Volumes of the Chemical Equivalents.—(First part.)—M. West.—This memoir consists of five parts, and treats of a statistic of more than 600 volumes of equivalents, the volumes being taken from all the densities mentioned in published classical works. This memoir is certainly of great value, but, unfortunately, not suited for any useful abstraction, and by far too lengthy for reproduction in full.

Polytechnisches Journal von Dingler, first number for July, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Artificial Production of Cold by Compression and Expansion of Air.—H. Bruhn.—This paper contains a review of the conditions required for the construction of machines contrived for the purpose of producing cold by the alternate compression and sudden expansion of air. The author proves that, although it might be possible to produce a very great cold by the means proposed, it fails to be economical in any respect.

Injurious and Poisonous Action of the so-called Tar Colours.—Drs. H. Eulenberg and H. Vohl.—The authors of this very lengthy memoir have, in writing it, kept in view the following points:—Is the pigment or dye prepared from substances which are by themselves poisonous? Has there been left in the pigment or dye any substance used during its preparation which, although not strictly belonging to the constitution of the pigment itself, is poisonous? Does the chemically-pure dye or pigment act injuriously on the animal body? Does the application and fixing of the dye to textile fabrics require mordants which are by themselves injurious, and a portion of which, either large or small, may remain in the fabric? The memoir is further divided into the following sections:—Aniline dyes; arsenical aniline green and picric acid; phenyl dyes.

Experiments on the Activity of the Süvern Disinfectant.—M. Hausmann.—The disinfectant alluded to consists of lime, chloride of magnesium, coal-tar, and water, in variable proportions. The mixture applied for experimenting contained, upon 240 parts of water, 100 of lime; 10, 40, or 70 of chloride of magnesium; and 6, 12, or 18 of coal-tar. This mixture has been tried for the disinfection of foul canal water, with the result that 1000 parts, by weight, of the latter required 10 parts, by weight, of the disinfectant for complete purification. Some experiments were instituted with each of the essential constituents separately, to try their efficacy in this respect; lime alone seems to be most active. Nothing is said about the nature or cause of the foul state of the canal water alluded to.

Purification of Oil of Turpentine.—Dr. Griiner.—The author says that, even the most carefully rectified oil of turpentine leaves, when applied for cleaning tissues or leather, an unpleasant smell after its evaporation. He states that this is entirely obviated if the oil is rectified by distillation over tannin, but no rationale of the action of tannin is given. The tissues treated with this oil should be dried at a temperature of 65°, and no smell will adhere to them.

Annales du Génie Civil, July, 1870.

This number contains, in addition to a series of papers on engineering, the following paper relating to chemistry:—

Madder: its Application to Dyeing and Printing.—D. Kæppelin.—The first portion of a lengthy memoir, giving, in the first place an account of the history of the dispersion of madder from its native soil into Europe, where it was re-introduced from the Levant by the Dutch, in the 16th century. By order of Charles V. it was cultivated in the Alsace, and, since 1789, in the then Comtat d'Avignon (now Département de Vaucluse). The author describes, at great length, the mode of cultivation of Marena madder, grown in the Derbent (a portion of Russia, formerly a Persian province). The soil of that district is a rich alluvial clay, containing a large quantity of calcareous matters and humus; the madder seed is sown in the November, and the roots are collected in the fourth following spring (April). The roots are first placed in well-aired sheds, and next submitted to a peculiar process of steaming, by being placed in what may be termed tanks dug in the soil, 2 metres deep and 1 wide. These tanks are first heated, by means of the combustion of wood, to such an extent, that the sides become red-hot; when this is effected, the madder-roots, previously watered, are thrown upon the smouldering embers; and when the hole is filled, covered over with coarse woollen cloths, and left in the hot tanks for six hours; the roots are then removed, and next dried in the sun. A great portion of this paper is, by the acknowledgment of its author, who has been in Russia, abstracted from the works of MM. Persoz, Girardin, Schützenberger, and others.

Journal für Gasbeleuchtung (two numbers), May and June, 1870.

These numbers contain the following papers relating to chemico-physical subjects and collateral sciences:—

Philipp's Carboxygen Illumination.—O. Kellner.—The author describes, at great length, the process of the manufacture of oxygen from protochloride of copper, obtained by heating the chloride of that metal, which, in order to prevent its caking together, is mixed with 33 per cent of broken pottery-ware. When submitted to heat, chlorine is first given off, according to the formula—

$$\left\{\begin{matrix}CuCl\\CuCl\end{matrix}\right\} = \left\{\begin{matrix}CuCl\\Cu\end{matrix}\right\} + Cl.$$

When the protochloride is exposed to moistened cold air, an equivalent of oxygen is taken up for that of chlorine previously given off, yielding—

$$\left\{\begin{matrix}CuCl\\CuO\end{matrix}\right\}$$

This taking up of oxygen goes on very rapidly, even with large masses, but becomes almost instantaneous in the presence of steam and air at 200°; while, at 400°, the oxygen taken up is given off again, and only requires cooling for the purpose of condensing the watery vapour it carries; after condensation, it is at once collected in gasholders. The cost price of the protochloride of copper is, in Germany, about 1s. 6d. per kilo.; 50 kilos. of this material yield from 1·3 to 1·5 cubic metres of oxygen gas.

Photometrical Studies.—Dr. F. Rüdorff.—Third and concluding portion of this lengthy paper.

Communications from the Committee of the Society of German Gas Engineers in reference to the Supply of Water to Towns.—This very interesting and lengthy memoir is divided into the following sections:—Waterworks of Hamburg; introduction and history; sources of supply; pumping machinery; canalisation and distribution of mains; regulations for the supply and use of the water; waterworks of Altona; waterworks of Vienna; waterworks of Schweidnitz (Silesia, Prussia).

Report of the General Annual Meeting of the German Gas Engineers at Hamburg, May 23—26 last.—This lengthy memoir contains nothing but what directly relates to the peculiar subjects discussed at such meetings. Chemical subjects have not been treated.

Revue Universelle des Mines, de la Métallurgie, et des Travaux Publics de Belgique, No. 2, 1870.

This number contains the following original papers and memoirs:—

Agglomeration of Fuel.—A. Habets.—The second portion of this very lengthy essay, illustrated by engravings, and chiefly treating of the best means of usefully applying the large quantity of small coal which becomes wasted at and near collieries and coal-pits.

Manufacture of Cast-Steel by means of the Refining of Pig-Iron with what is termed Intermolecular Combustion.—S. Jordan.—This lengthy memoir contains the following chapters:—General review; combustion of iron, of manganese, of carbon, of silicium; refining by means of atmospheric air; refining by means of steam; refining by means of oxygen.

Researches on the Permanent Motion of Gases through Pipes and Tubes.—Dr. Grashof.—An algebraico-physical essay.

Annales des Mines, No. 3, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and allied sciences:—

Geological Notes on Oceania, the Islands of Tahiti and Rapa.—J. Garnier.—A very lengthy and valuable monograph on the geology of these far-distant countries.

Process of Desilvering Lead, as Executed at the Works of MM. Herbst, Brothers, at Call (Eifel, Prussia).—R. Zeiller and A. Henry.—The authors describe, at length, a peculiar process of desilvering lead by the aid of zinc, especially suited for the conditions of the works where these manipulations are carried out. The authors state that the process is effective and cheap in every respect, labour included.

Accident in a Beet-Root Sugar-Works at Cruzin (Nord, France).—J. Callon.—It appears that one of the steam-boilers of the beet-root sugar-works of MM. Miroux and Co., at Cruzin, after having been out of use for several months, had to be cleaned before being put in operation again. The water contained in the boiler at the time of stopping its work had been let off by the usual means; but, from some cause or other, the boiler and brickwork of the furnace (as found after the accident to be mentioned) had become slowly inclined backward, and, as a consequence thereof, a portion of the water was left; nothing, however, indicated, on opening of the man-hole, that the air in the boiler was greatly vitiated and unfit to support life. One of the workmen, who entered the empty boiler for the purpose of cleaning it, was, on approaching the end of it where the water had remained stagnant, almost instantly killed by the putrid miasmas given off; and the man who dragged the almost lifeless body out of its dangerous position was saved with difficulty. The author of this paper, who is a member of the Central Committee for the Surveillance of Steam-Engines, states that no other case of such an accident having occurred is on record, but that the cause is undoubtedly due to the vitiated air in the confined space, the vitiation being caused by the putrefaction of organic matters collected in the water left in the boiler.

Mineral Resources of the Ariège.—(Third part.)—M. Mussy.—The concluding portion of this lengthy monograph. This portion includes the mineral waters, with analyses, but their number is too large for specific quotation here.

Bayerisches Industrie und Gewerbe Blatt, May, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Depositing Zinc upon Copper or Brass, in the Wet Way.—Dr. R. Böttger.—The author first prepares finely-divided zinc, by pouring the molten metal in a previously strongly heated iron mortar, and stirring until nearly cold. The pulverulent zinc thus obtained is placed in a porcelain vessel, and to it is added a concentrated aqueous solution of sal-ammoniac. This mixture is heated to boiling; and the copper or brass objects to be coated with zinc (but previously well-cleansed, and, best, even with an acid) are then placed in the liquid, wherein they become coated with a brilliantly-white adhering layer of zinc.

Chemical Investigation of a Bohemian Lager Beer.—A. Vogel.—The sample analysed had been kept for two-and-a-half years in casks; the liquor had a deep brown colour; its taste was pleasant, but not bitter. One litre of this beer contained—Water, 878·4 c.c.; extract, and other following substances, in grms., 70·5; alcohol, 48·8; carbonic acid, 2·3; sugar, 5·0; phosphoric acid, 0·58; nitrogen, 0·46; ash, 2·4.

Paper and Millboard from Peat.—M. Oppermann.—The author states that M. Halbach, paper maker at Leer (Hanover), has succeeded in employing, along with straw, the fibrous matters met with in peat bogs for the manufacture of coarse paper and millboard.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, July 15, 1870.

This number contains the following original papers relating to physico-chemical and collateral sciences:—

Researches on the Magnetic Rotatory Polarisation of Liquids.—A. de la Rive.—This very lengthy memoir is divided into the following paragraphs:—Description of apparatus and method of experimenting; determination of the specific magneto-rotatory power of some liquids—viz., alcohol, sulphide of carbon, sulphuric acid, sulphurous acid; influence of the temperature upon the magneto-rotatory polarisation of liquids—viz., alcohol, iodide of ethyl, amylic alcohol, distilled water, and sulphuric acid, ($HOSO_2$); determination of the magneto-rotatory power of a mixture of two liquids; determination of the magneto-rotatory powers of some isomeric liquids—viz., acetate of amyl, valerate of ethyl, butyrate of isopropyl, amylic alcohol, hydrate of amylen; conclusions drawn from the experiments.

Cretaceous Formations met with in the Exterior Alps on Each Side of Lake Léman.—V. Gilliéron.

Radical of Phthalic Acid.—E. Ador.—The author describes, at great length, the complicated reactions by which he obtained phthalyl, a crystalline compound, insoluble in water. Alcohol, ether, chloroform, acetone, sulphide of carbon, acetic acid, and carburets of hydrogen dissolve only a very small quantity of phthalyl; its best solvent is boiling phenic acid. Phthalyl is sublimable at a high temperature, and is strongly acted upon by bromine and sulphuric acid. The formula of phthalyl is $C_8H_4O_2$. Concentrated nitric acid converts phthalyl, at boiling heat, into diphthalic acid, $C_{16}H_{10}O_8$, a white-coloured crystalline substance, somewhat soluble in water, fusing at 259°, and yielding then anhydrous phthalic acid.

Les Mondes, August 11, 1870.

Pindray's Smoke-Consuming Furnace.—M. Tilloy.—The author, proprietor of a large factory, states that he has had constructed a 70-H.P. steam-boiler, with furnace and flue arrangement according to M. Pindray's plan, and that he has every reason to be highly satisfied with this arrangement, whereby he daily saves 15 hectolitres of coals; emits no smoke or combustible gases from the chimney; keeps up steam at full pressure, even when clearing the fires; whilst with the combustion at its greatest activity, the bottom of the fire-bars is hardly hot. We do not know what M. Pindray's arrangement really consists in, but we can readily affirm, by experience, that such results may be arrived at, even with multitubular marine boilers.

International Scientific Relations.—Dr. A. Boué.—The author calls attention to the fact, that a great many scientific publications of the northern and easterly parts of Europe remain, unfortunately, almost unknown, save in the countries where the languages (Swedish, Danish, Finnish, Lithuanian, Russian, Czech, Slavonic, Magyar, Polish, Neo-Greek, and Roumanian, to which may be added Dutch) in which they are published are vernacular. The author proposes that it would be an advantage if, for each of these publications, either a full translation or an abstract of the papers were simultaneously published in French, English, or German.

Use of Iron in Homer's Period.—F. De Hauer.—This paper, chiefly of historical interest, contains, among other interesting facts, the opinion, defended, that the oldest iron ever in use was of meteoric origin, and therefore contained nickel. That copper and bronze were far earlier known and used than iron or steel, which latter, however, have been well-known to all purely Germanic races probably before these metals were known in some more easterly countries.

Aspect of the Environs and Basin of Paris shortly before and during the First Apparition of Man.—E. Robert.—An archæologico-geological paper of value, but too lengthy and too special to admit of any useful abstraction.

Cosmos, August 13, 1870.

Composition of Rain-Water.—Dr. G. Tissandier.—The author has analysed some rain-water fallen at Paris on the 1st and 8th of July last. The portion (only some drops purposely collected on watch-glasses) which fell on the first-named date contained no less than 4·68 per cent of solid matter; microscopical observation proved the existence therein of *débris* of woven tissues, threads, coal-dust, starch granules, sand, and *débris* of wood. On being evaporated, a drop weighing 0·032 grm., and then seen under the microscope, was proved to contain crystals of nitrate of ammonia and crystals of common salt. On the last-named date, a litre of water was collected on the top of a roof in Paris; this water, on being analysed, yielded a total solid dry residue of 0·0658 grm., containing—Insoluble mineral matters, 0·0108 grm.; insoluble organic matter, 0·0340 grm.; soluble salts, 0·0210. This rain-water was found to contain 0·020 grm. of nitrate of ammonia; and, since this salt contains 35 per cent of nitrogen, it follows that the 10 m.m. of rainfall of the 8th of July carried down 70 grms. of nitrogen per hectare, besides the organic matter.

Ancient Glaciers of the Auvergne.—J. Marcou.—A lengthy geological paper. The author comes to the conclusion that glaciers have existed in the Auvergne before the volcano of the Puy de Dôme and Mont-Dore were uplifted.

TO CORRESPONDENTS.

*** The Student's Number of the Chemical News will be published on Friday, September 9th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

A Reader, W. R., and others.—Professor Storer's work on Analysis is not yet out; it will be published in the United States. We do not know the price at present, but will give full particulars as soon as possible.

T. Dearden.—The preparation of precipitated colours is treated in Gentele's "Lehrbuch der Farbenfabrikation," and also in Cooley's "Cyclopœdia of Practical Receipts."

Dr. Stenhouse, F.R.S., C. Tomlinson, F.R.S., and A. Liversidge, are thanked for their communications.

THE CHEMICAL NEWS.

VOL. XXII. No. 562.

EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.*

By FRANK H. STORER,
Professor in Massachusetts Institute of Technology.

(Continued from p. 99).

EXPERIMENT III.—*Estimation of Chlorine in Chloride of Sodium.*

HEAT a quantity of pure powdered chloride of sodium in a porcelain crucible, in order to expel hygroscopic moisture. Weigh out about 4 grms. of the dry powder, place it in a glass flask of about a litre capacity, and dissolve in 200—250 c.c. of water. Heat the solution moderately, add to it a quantity of nitrate of silver solution, cork the flask and shake it strongly. As soon as the chloride of silver has become curdy and coherent, and the liquid clear, add to the latter a drop more nitrate of silver. If a fresh precipitate is produced, add as much more nitrate of silver as may seem fit, again heat and shake the liquor, and repeat these operations until the addition of a drop of nitrate of silver ceases to produce any precipitate. Wash from the cork any particles of chloride of silver which may adhere to it, fill the flask completely with water, close its mouth with a small glass plate, invert it in an evaporating dish (a No. V. Berlin dish will do) two-thirds full of water, and remove the glass plate, shake the flask gently until all the chloride of silver has fallen from it into the dish, then remove the flask from the dish by a sudden jerk, in such manner that none of the chloride of silver shall be thrown from the dish. Finally, transfer the precipitate from the dish to a 6-inch filter, and wash it with hot water, until the filtrate ceases to leave any residue when evaporated on glass. Dry the precipitate, transfer it to a porcelain crucible, taking care to leave as little of it as possible upon the paper. Burn the filter on the cover of the crucible, and afterward heat the precipitate in the crucible until the mass begins to fuse upon its edges.

Four grms. of chloride of sodium gave 9·7825 grms. of chloride of silver (=2·4192 grms. chlorine), or 60·48 per cent. Theory required 60·66 per cent.

(To be continued).

ON THE ACTION OF NUCLEI.

By CHARLES TOMLINSON, F.R.S.

THERE are a few points in the two notes by Mr. Liversidge that require notice.

1. *Do nuclei act when wet?*—This point was first noticed by Ziz, of Mayence, in 1809.† He found bits of iron wire, flint, glass, small coins, &c., caused supersaturated solutions of sulphate of soda to crystallise; but, if previously wetted, these bodies become inactive. In noticing these experiments a few years ago,‡ I attempted to define the conditions under which dry active nuclei may be rendered inactive while still dry; and I endeavoured to show that, "if previously wetted with water, they are not wetted by the solution when thrown into it, and, consequently, cannot act as nuclei, because the solution does not really come in contact with them." It will be found, however, that the statement, *nuclei do not act when wet*, is far too general in its terms. All that can be said is that they sometimes, or often, do not act, or they do not act at once, for it may happen that wet unclean nuclei do act after some hours; whereas, if such nuclei be boiled up with the solution, and so made clean, they never act, though the solution be kept for months and be shaken every day. Löwel also noticed* that rods of glass, &c., kept in cold water, become *partially*, or wholly, inactive. Such rods, partly immersed in sulphuric acid or caustic alkali, and dried out of contact with air, are wholly inactive to the extent of the immersion, as may be shown by plunging them into soda-water, boiling water, or a supersaturated solution of Glauber's salt. There will be no liberation of gas, or vapour, or salt, but, on inserting the unclean end, it will act as a powerful nucleus.

2. *What is meant by chemically clean?*—Having proved, I think, that bodies are *nuclear* or *non-nuclear*, according as they are not, or are, chemically clean, a definition of the term "chemically clean" was required. It was justly urged that a definition which excludes oils and fatty bodies could not be accepted, since these may be as clean as a catharised glass rod. After much experimental research, I arrived at the following:—"A substance is chemically clean whose *surface* is free from any substance foreign to its own composition."

This definition is so far guarded, that it refers to *surface* only. A glass rod, for example, is regarded as chemically clean, even though a particle of carbon or oxide of iron be enclosed and shut off within it; but not so if that particle reach, and form part of, the surface itself. Such a particle, if porous, acts as a powerful nucleus in separating vapour from a boiling liquid, and it also may act as a centre of crystallisation in a solution. So, also, a phial may be chemically clean as to surface, even though it enclose nuclear particles; and "a mixture of wax, oil, soot, dust from the floor, sodic sulphate, soap, &c., melted together on a glass rod," may be a clean surface of wax, enclosing unclean particles.

3. *Can the finger be made chemically clean?* In a paper on "Some Effects of a Chemically Clean Surface,"† I refer to the delicate test of chemical purity afforded by the motions of camphor on water. Camphor was rotating briskly in the surface of water, in four glasses, A, B, C, D, when I put my finger into A, my tongue into B, the glass C was emptied and filled up with water from a jug that was in domestic use, while D was emptied, wiped with a glass cloth in ordinary use, and filled up with clean water. Fresh fragments of camphor were scraped upon all four glasses, and they were motionless on A, C, and D, thus showing that the surface of the water in each of these cases had contracted a nuclear film. In the same paper it is shown that other phenomena which depend for their action on the state of chemical purity are at once arrested "if the finger or other chemically unclean body be made to touch the water."

In a popular account of this paper given in one of the journals, I am made to say "that the finger cannot possibly be made chemically clean." This statement was met by an experiment by Prof. Van der Mensbrugghe.‡ He admits that the motions of the camphor are instantly arrested if the water be touched with the finger, and adds, "Ces effets sont certainement dus à la couche graisseuse adhérente presque toujours aux doigts; car, si l'on a préalablement soin de se laver les mains avec de l'alcool, puis avec de l'eau distillée, le contact de la surface liquide avec le doigt n'arrete plus les mouvemens du camphre."

What I really did say, was, that the finger cannot be made chemically clean in the sense that a glass rod is so cleaned;‖ since the finger, however protected from external influences, generates, of itself, a nuclear action. I

* Communicated by the Author. From the *Massachusett's Teacher.*
† Schweigger, *Journal für Chemie und Physik*, xv., 160.
‡ *Philosophical Magazine* for August, 1867.

* *Annales de Chemie et de Physique* for 1850.
† *Phil. Mag.* for October, 1868.
‡ *Memoires Couronnés de l'Academie Royale des Sciences de Belgique* for 1869, Tom. xxxiv.
‖ *Journal of the Chemical Society*, xxii., 130.

performed an experiment with the view to determine, if possible, how long the finger, being made chemically clean, would remain so. The finger was first thoroughly washed in a solution of soap, then in alcohol, and, lastly, under a stream of water, and so dipped into water, on the surface of which the camphor fragments were spinning briskly. The finger was retained under the surface of the water, and slid along about an inch in length of the surface of the glass below the water. In less than two minutes the camphor fragments were brought to rest, and they did not recover their activity.

I have, on several occasions, put the clean finger into highly supersaturated solutions of sodic acetate with no effect, until a smear was produced by drawing the finger with pressure against the side of the glass, when the solution immediately became solid.

In experiments of this kind the results may vary according as the skin is naturally moist or dry, soft or hard; just as it is said to happen occasionally when a chain of hands is formed for the passage of an electric shock, the skin of one pair of hands is so dry that it acts as an insulator for a weak charge. I think it likely also that, by passing the finger through flame, it might not arrest the camphor motions when first put into the water, any more than act as a nucleus when just dipped into a supersaturated solution of Glauber's salt.

4. *Is an iridescent film ever inactive?* I need not repeat what has been already said respecting the limitations to my definition of chemical cleanliness, namely, that oils and fatty bodies, if clean, are not nuclear in the lenticular state, but are so in the condition of films. Mr. Liversidge, if I understand him rightly, has noticed iridescent films of oil, &c., on the surface of a supersaturated solution of Glauber's salt, that did not act as nuclei. This does not agree with my experience, but I may remark that in researches on the action of nuclei some attention must be paid to temperature. Solutions vary so much in sensitiveness as the temperature rises or falls, that experiments that succeed very well in winter may fail altogether in summer. This is especially the case with weak solutions, which may be supersaturated in cold weather but are only saturated in warm; and, of course, when saturated only, the observations as to the action of nuclei fail to apply.

A striking example of this kind is afforded in a paper by M. E. Lefebvre* on the "Supersaturation of Calcic Chloride," in which a large number of bodies are tried as to their nuclear action, and arranged into classes according as they do or do not act; whereas if the solution of the strength indicated be sufficiently reduced in temperature any one of the bodies which are said to be inactive may become active. The films formed by oils on the surface of highly supersaturated solutions of sodic sulphate produce, in cold weather, very fine prismatic plates of the 10-atom salt with dihedral summits; whereas, the same film acting on a solution of the same strength in hot weather produces much smaller crystals, far less perfectly formed. A strong solution of calcic chloride may be quite passive to the action of nuclei in hot weather; but if the vessel be put into a freezing mixture it becomes highly sensitive.

Highgate, N., August 27th, 1870.

THE NIIN OF YUCATAN.†

A COMMUNICATION from Dr. Arthur Schott, late of the Scientific Commission of Yucatan, furnishes some descriptive statements concerning an insect, and the nature and uses of a grease-like or wax-like product, with the result of a chemical examination of its properties.

Among the numerous interesting natural productions of Yucatan, not the least remarkable is the niin (pronounced *neen*), the knowledge of which, and of its technical application, has survived the national independence of the gifted Maya race. The niin is the grease of an insect bearing the same generic name. The niin may be considered akin to the cochineal, also the product of a similar insect; but they differ essentially in their nature, one serving as a well-known dye, while the other finds its application as a drying oil.

The nature of the niin will be clearly understood by the annexed scientific analysis, made by Mr. V. G. Bloede, analytical chemist, of New York. The matter examined by that gentleman consisted of a small quantity which Dr. Schott brought some time before from the city of Merida, Yucatan.

The analysis is as follows:—

The Yucatan niin is a yellowish-brown, fatty mass, having a peculiar oily odour. In its general properties it seems closely allied to hog's lard or suet. It is neutral to test-paper, neither presenting acid nor alkaline reaction, though, when exposed to the air, it acquires a very faint tendency to manifest the former. Its melting point is about 120° F., though, when once melted, it still remains in a semi-fluid state with the temperature as low as 80° or 85° F. When cooled to 10° F., it becomes hard and brittle, like suet. At ordinary temperatures, that is, about 60° F., it is of a thick, pasty consistency, like ordinary lard. Its specific gravity at 60° F. is about 0·92.

Its Solvents.—In regard to solvents, the niin presents the same general properties as any ordinary animal fat. It is not soluble in either hot or cold alcohol, even after extended maceration. It is freely soluble in both hot and cold ether, with which it forms a yellow, oily liquid. It is very soluble in turpentine, with which it forms an oily liquid possessing peculiarly valuable properties for mixing delicate oil colours, of which I shall speak hereafter. It dissolves freely in benzine; chloroform, also, is among its best solvents.

Chemical Properties.—The niin, in its classification in organic chemistry, must undoubtedly be ranked among the drying oils, though its absorption of oxygen takes place rather more slowly than with many other oils. Nor is this slowness in drying accelerated to any extent by boiling it with oxide of lead. It is the first, or nearly the first, example we have of a thoroughly drying animal butter or solid fat. Like some others of the animal fats, it contains a distinct volatile acid peculiar to itself. As, for instance, butter contains butyric and caproic acid; goat's fat, hircic acid; so the niin contains an acid of a peculiar, pungent smell, which might be aptly termed niinic acid. Its chemical composition differs little from ordinary animal fats. Like others, it contains a fluid oil—oleine—and a solid containing stearic, margaric, and other fatty acids. A portion of the acids may be obtained by dissolving the niin in turpentine or ether. The oily portions pass into solution, while a solid precipitates, consisting of the acids indicated, which may be separated from the fluid by filtration.

Saponification.—A peculiarity of the niin seems to be its difficult saponification. The strongest ammonia procurable has no saponifying action on it. Even if the fat be digested in ammonia for several days, no liniment is formed, but a marked transition from yellow to red seems to be the only change produced. This change of colour depends merely on the action of ammonia on the colouring matter of the niin, which, like the yellow turmeric (*Curcuma longa*), changes to red as it assumes an alkaline reaction.

With potash, too, it saponifies but slowly and imperfectly, and a concentrated lye is necessary. With soda it forms a soap only after extended boiling with a strong lye. It is only after several hours' boiling with oxide of lead that it forms the so-called "lead soap," and then the product is very imperfect. From these facts we can at once deduce that the niin cannot be considered

* *Comptes Rendus*, March 28, 1870.

† From the Report of the United States Commissioners of Agriculture.

a "good saponifying fat," but belongs to the "drying oils."

Effects of High Heat.—When the niin is melted in a porcelain dish, and the resulting oil exposed to a continued and high heat (between 250° and 350° F.) for an hour, or until a considerable portion of it has evaporated, the residue in the dish will then be found to have assumed a tough, flexible, varnish-like condition—a gelatinous mass no longer soluble in turpentine, or affected by heat or cold, at least to a great extent.

If a piece of this gelatinised niin is placed on a piece of porcelain, moistened with turpentine, and ignited, another remarkable change takes place; for, if the plate is slightly inclined as the mass burns, a thick, yellow, resinous oil or gum flows from it, which possesses most remarkable adhesiveness, closely resembling a thick solution of india-rubber, but which does not dry, retaining its half-fluid consistency for several days. This is a most singular change, and one that is worthy of further investigation.

Change of Air.—When the turpentine solution of the niin is exposed to the air in thin strata for a few days, it acquires the properties of a resinous varnish; in fact, the change is so complete, that when some of the solution is poured on a piece of glass it dries almost equal to fine shellac varnish. This change is due to the absorption of oxygen. If further developed, this property will undoubtedly make the niin of the greatest commercial value. The film of varnish is very elastic, and, at the same time, hard, which renders it superior to some of the other gums. An alcoholic solution can also be formed, but this is more difficult.

Suggestions as to Use.—The extreme oiliness of the niin will undoubtedly make it very valuable for various purposes in the arts; and its "drying" solution in turpentine has no equal for mixing fine colours for artists. This turpentine solution of the niin produces a remarkable brightness in the colours prepared with it, and they dry rapidly. But the chief value of the niin, which will give it commercial importance, is its property of forming a resinous varnish when treated as before described, rendering it superior to shellac for some purposes. Another valuable application of the niin could be found in the manufacture of waterproof fabrics. A piece of the most porous Swedish filtering paper, saturated with a solution of the niin diluted in turpentine, will not allow a drop of water to pass through, even after standing in it for days. An excellent way of water-proofing would be to saturate the article with melted niin, and then expose it in an oven to considerable heat until the grease gelatinises. By these means the niin becomes insoluble, not only in water, but also in most of its solvents. If the niin can be obtained, as Dr. Schott says, in "unlimited" quantities, it will, doubtless, in time become of great commercial value.—*Scientific American.*

NOTE ON ITACOLUMNITE.

By Professor A. M. EDWARDS.

To those accustomed to the use of the microscope it is not a matter of surprise that persons who do not commonly employ that instrument in research should make very serious mistakes in interpreting what they think they see by means of it, the more especially when high powers of magnification are made use of. The delicacy of manipulation necessary to work with the microscope at all satisfactorily, and the education of the eye required for the proper seeing by means of it, are not generally understood, so that those who are not skilled microscopists are extremely liable to be led into error. What I am inclined to consider a case of this kind has lately been brought to my attention, and I am persuaded to make a note of it, the more for the purpose of correcting a grave error in investigation, and one which is, strange to say, readily demonstrated to be an error.

In 1867 (*American Journal of Science*, vol. xliv.), Dr. C. Wetherill published a well-written and seemingly-exhaustive paper, setting forth some "Experiments on Itacolumnite, with the Explanation of its Flexibility, and its Relation to the Formation of the Diamond." In attempting to elucidate the flexibility of this rock he has made use of the microscope, and, in fact, mainly draws his conclusions from the revelations which he supposes that instrument makes. Some specimens of itacolumnite, varying in tint from almost pure white to a rusty red tint, and in texture from finely granular to coarse and distinctly laminated, having come into my hands, I have been enabled to examine into this point of structure and attendant flexibility, which I have done with some care.

It is well known that itacolumnite is the accompaniment, and often the matrix, of the diamond; hence the interest which attaches to its peculiarities, as it would seem in some way to be connected with the occurrence or formation of that gem. Detecting dark coloured grains in it, Dr. Wetherill considers them to be black diamonds, and doubtless he is correct in his supposition, but with this portion of his paper I do not desire to deal at the present time. It is with regard to the structure of the sandstone, whereby it becomes flexible to the remarkable degree so evident when thin slabs are examined. The stone is plainly laminated, and has clearly been thrown down beneath water, it being readily cleavable into more or less distinctly marked laminæ.

Almost universally the flexibility is attributed to the presence of mica, but the brighter-coloured specimens which I have examined contain no mica, and yet possess the property of being readily bent to a very marked degree. Even in the red-tinted specimens there are large portions in which no mica is found. Dr. Wetherill says, that by examining the itacolumnite by means of the microscope, he has been enabled to ascertain that the "flexibility is due to *small and innumerable ball-and-socket joints* which exist throughout the mass of the stone very uniformly. Each joint permits a slight movement which is always greater in one direction." Now, I must say that, though I have come to the investigation prepared with considerable faith, yet, after many careful examinations, I was never able to force my imagination to the extent of getting it to show me anything resembling ball-and-socket joints. The examination need not always be made of the opaque sandstone, but portions can be roughly crushed and mounted in Canada balsam, so that light may be transmitted through them, and the mode of their interlocking plainly made evident. The fact is that the rock is made up of small, broken, irregular masses of transparent sand, which evidently have not been carried any great distance by water, as their sharp edges have not been at all abraded, but, on the contrary, remain, but they have evidently been broken off from a rock which had a conchoidal fracture, they being little plates of extremely irregular outline. Thus, when they settled in the liquid in which we can suppose them to be thrown down, they naturally, for the most part, distributed themselves with their greatest axes in the same direction, and hence the lamination and cleavage of the rock itself. We can readily understand that in such a rock, if the particles were not strongly held together, that they would possess a certain amount of motion one over the other, and this motion would be most marked in a direction at right angles to the lamination, which is the case. But, also, such a rock would not be elastic, only flexible, and gradually, after several times bending, be broken. Such is exactly the case with itacolumnite. In fact, any one possessing a microscope and a fragment of this rock can readily verify my observations, and demonstrate that Dr. Wetherill's proposed name of articulite

* From the *Proceedings of the Lyceum of Natural History, New York.*

is inappropriate for itacolumnite. In conclusion, I would mention that grains of the crushed rock, when put up in Canada balsam, become very beautiful objects for examination by means of the micro-polariscope, exhibiting a gorgeous display of colours when the interposing selenite film is used.

POTASH SALTS FROM SEA-WATER—BALARD'S PROCESS.*

By J. LAWRENCE SMITH.

This is another mineral source of potash salts, and it was first devised by Balard some sixteen or eighteen years ago, and has been carried on successfully for many years, but is now seriously interfered with by the supply from the new source of potash in the deposits of potash compounds called "Sylvine" and "carnallite," found occurring in the rock-salt mines of Stassfurt.

By Balard's method the potash salts are obtained in treating the mother-liquor of sea-water salt works, which we may regard as essentially composed of chloride of potassium, sodium and magnesium, and sulphate of magnesia. The object in view is to bring all the sulphuric acid into combination with the soda, and then to obtain, by separate crystallisations, the chloride of sodium, the chloride of potassium, and the chloride of magnesium; the last, being of but little practical value, is allowed to run to waste. The means used to accomplish the results are altogether physical, namely, the abstraction of heat by natural or artificial means. It is based on Scheele's observation, made a great number of years ago, that if a mixture of chloride of sodium and sulphate of magnesia in solution be reduced below freezing point, a double decomposition takes place, and crystals of hydrated sulphate of soda are formed, and chloride of magnesium remains in solution. The separation of the mixed chlorides is made by boiling and cooling the mother-water freed from the sulphate of soda. The original process of Balard was much improved by M. Merle, who employs an artificial cooling process. The following is a detailed description of his process, as communicated by him to the chemical reporters of the London Exposition in 1862.

The process may be shortly defined to consist in the further concentration of concentrated sea-water by exposure to a low temperature, artificially produced. The degree of concentration requisite to fit sea-water for treatment by this process is 1·24 sp. gr., (28° B.,) at which point of concentration sea-water deposits about four-fifths of the culinary salt contained in it.

This degree of concentration is obtained by the ordinary process of evaporation on the ground as practised in the manufacture of common salt, of which the ample crop obtained repays this preliminary operation. The mother-liquor which remains is the raw material of the new process. It is stored in large covered tanks, and from this point forward it undergoes no further exposure to dilution by rain, or to absorption by the soil. It is withdrawn from the ordinary operations of the salt gardens, from which M. Merle borrows the one first step—concentration of 1·24 sp. gr. (28° B.) As, however, this degree of concentration is found to be a little beyond the density most favourable to the next stage of the operation, ten per cent of pure water is added to the liquor in the tanks. Thus prepared, the concentrated sea-water is next passed through refrigerating vessels, which are constructed on Mr. Carré's principle, and which cool it to 18° C. This artificial refrigerator causes the desired double decomposition to take place between the sulphate of magnesia and chloride of sodium, sulphate of soda being deposited by the water as it passes through the machine, and chloride of magnesium being carried away in solution. The process is continuous. The water passes constantly in at one end of the apparatus and out at the other, and the deposited sulphate of soda is continuously withdrawn from the apparatus by a chain of buckets. This salt is speedily freed from mother-liquor by a centrifugal hydro-extractor, and is finally dried in a reverberatory furnace. The utility of the above-mentioned dilution of the tank liquors is now made manifest. If cooled down while at their original density (28° B.) they would let fall much hydrated chloride of sodium, along with the sulphate of soda, to the detriment of its purity and value. But in consequence of the dilution the culinary salt remains dissolved, together with potassic and magnesic chlorides, in the mother-liquor which flows away from the machine.

This mother-liquor has now to be treated for the recovery of the salts it holds dissolved. For the recovery of the culinary salts the mother-liquor is made to flow from the cooling machine directly into boilers like those used in refining rock salt, In these it is boiled down to 1·331 sp. gr. (36° B.), by which time it has deposited nearly the whole of its common salt in a fine powder, which, when dried in a centrifugal machine, equals for purity the best English refined salt. It only remains now to recover the chloride of potassium still dissolved in the hot liquor, which, for this purpose, is poured forth to cool in extensive shallow coolers formed of concrete. Here it soon deposits the whole of its potash as a double chloride of potassium and magnesium. This deposit (a kind of artificial carnallite) is collected, and the magnesic chloride is eliminated therefrom by adding to the mixed mass half its weight of fresh water. This dissolves the whole of the more soluble magnesic chloride, but only one-fourth of the potassic choride. Three-fourths of the potash are thus obtained as a chloride, containing only one-tenth of extraneous saline matter; the remaining fourth, dissolved with the magnesic chloride in the wash-water, is returned to the boilers.

This capital process works with the utmost ease and regularity. The energetic action of the artificially lowered temperature not only dispenses with the successive eliminations which form the basis of M. Balard's method, but causes the double decomposition to take place with such intensity that the mother-liquors retain but a small proportion of sulphate of magnesia, and lend themselves with ease to the further treatment for obtaining the potash salts. Thus, when the liquid is heated in the boilers, nearly the whole of the chloride of sodium separates without carrying down with it any potash; and when the double chloride is deposited by the subsequent cooling, no potash is left in the waste liquor. The whole of the potash is thus precipitated as double chloride; and this salt being very pure, nothing more is required, in order to obtain separately the chloride of potassium, than to wash out the chloride of magnesium with cold water, and to dry the residue in the centrifugal machine. A very remarkable feature of M. Merle's process is the great facility with which the chloride of sodium is obtained in a finely divided state by ebullition in the boilers. If the liquor of 1·24 sp. gr. (28° B.) were boiled down without previous elimination of the sulphate of magnesia by the above-mentioned cooling process, crusts would form on the bottom of the boiler to such an extent as to hinder the operation greatly, if not entirely to stop it. But the double decomposition which takes place under the influence of cold, by depriving the liquor of sulphate of magnesia, and rendering it rich in chloride of magnesium, changes these conditions. Indeed, the liquor thus treated may not only be boiled down without the formation of the strongly adhering earthy deposits which would otherwise appear, but it does not even produce the slight crusts which form during the refining of rock salt; so that the preparation of the refined salt is carried on under very favourable conditions. Ease and regularity are not, however the only characteristics of this process. It is remarkable, also, for the large quantity of saline products which it is capable of yielding. In fact, the salt-work

*From the "Progress and Condition of Several Departments of Industrial Chemistry."

operation being limited to the production of a liquor of 1·24 sp. gr. (28° B.) on the ground, the loss arising from the permeability of the soil is quite insignificant, and not to be compared with the serious waste which results from this cause when the treatment of the liquor in the salt gardens is continued to much higher degrees of concentration, according to the earlier practice. In point of fact, the first stage of the treatment in the salt works, according to the original method, becomes the last stage in the improved plan. The saline water of 1·24 sp. gr. (28° B.) once transferred to the large tanks remains, during all further stages of the process, in metallic vessels; and, as the subsequent operations are conducted without loss, an amount of product is obtained which, when large evaporating surfaces are employed, may become enormous. A cubic metre of liquor at 28° B., which, if no loss occurred, would correspond to 25 cubic metres of sea-water, but which, in consequence of the loss occasioned by infiltration, is equivalent to 75 cubic metres of sea-water, yields, when treated as above described, 40 kilogrammes of anhydrous sulphate of soda, 120 kilogrammes refined culinary salts, and 10 kilogrammes of chloride of potassium.

LIQUEFACTION OF CYANOGEN FOR LECTURE EXPERIMENTS.

By Dr. A. W. HOFMANN, F.R.S.

TAKE a piece of combustion-tube about 30 centimetres long, and sealed at one end; at the open end, fix, by means of sealing-wax, a brass cap fitted with a well made brass tap, furnished, in the axial direction of the tube, with a corrugated hose socket. In order to remove the air from this apparatus, a glass tube of narrow diameter is made to pass through the opening of the stopcock into the combustion tube, and carried down to the sealed end thereof; cyanogen gas is conducted through this narrow tube into the apparatus until the gas issuing from the brass socket exhibits, on being ignited, the genuine characteristic cyanogen flame; the narrow glass tube is then withdrawn, and the stopcock shut. The cyanogen gas condensation apparatus consists of two strong flasks, each of a litre capacity, and furnished, at or near the bottom, with tubulatures; these flasks are connected together by means of strongly-made india-rubber tubing enclosed in a stout canvass hose, and 1½ metres in length. One of these flasks is placed somewhat higher than the other, in such a manner that, if the lower is filled with mercury up to the neck, this metal rises in the other flask above the lateral tubulature. In the neck of the flask filled with mercury (lower flask), a perforated cork, carrying a glass tube bent twice at right angles, is inserted, and the cork is fastened to the neck with thin iron wire. The glass tube ought to have the same diameter as that of the brass hose socket, and, like that, should also be corrugated. The glass tube is next connected with a cyanogen gas yielding apparatus, best constructed for this purpose of a piece of combustion-tube, connected with a contrivance for condensing the mercury, filled with cyanide of mercury, and placed in a combustion furnace. By gradually lowering the empty flask, which has been placed highest, the other flask, which contains mercury, becomes gradually filled with cyanogen gas, the mercury running off. The first-mentioned condensation-tube apparatus is next placed in a freezing mixture, consisting of ice, common salt, and some chloride of calcium, yielding a temperature of −25°. The cyanogen-yielding apparatus having been first removed, the glass tube is connected with the brass hose socket of the condensation apparatus, kept in the freezing mixture, by elevating the litre-flask filled with cyanogen gas, and causing the mercury it at first contained, and which had run into the other empty litre-flask, to run into the flask containing the cyanogen gas; that gas is forced into the condensation apparatus, the stopcock of which is closed; immediately after, the flask which contained the cyanogen gas is filled with mercury again. The condensation apparatus, having been disconnected from the flasks, is taken out of the freezing mixture, and will be found to contain about 5 c.c. of liquefied cyanogen, which keeps unaltered for weeks, and can be experimented with by means of the stopcock fitted to the apparatus.—*Berichte d. Deutsch. Chem. Gesell. zu Berlin.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor TYNDALL, LL.D., F.R.S.

(Continued from p. 106.)

Magneto-Electricity: Induced Currents.

274. In a conductor near to, but not in contact with, a voltaic circuit, a current is aroused when the circuit is *established*. When the circuit is *interrupted*, a current is also aroused in the conductor.

275. Thus, supposing the voltaic circuit to be bent into the shape of a ring; and that a second ring, not in the circuit, is placed near the first: at the completion, and at the interruption of the circuit, a current will run round the second ring.

276. The two currents in the second ring are called *secondary* currents. They are of momentary duration. They impart, in passing, a shock to a magnetic needle round which they are sent, and by the motion of which their existence is demonstrated. But they vanish immediately, being quenched by the resistance of the ring and converted into heat.

277. These two momentary currents flow in opposite directions through the ring. The secondary current, excited on making the circuit, is opposed in direction to the primary exciting current; that started on interrupting the circuit flows in the same direction as the primary.

278. These secondary currents are called *induced currents*. They were discovered by Faraday in 1830, and described by him in his Philosophical Papers for 1831.

279. If, instead of employing a single ring, we make use of an electro-magnetic helix, every coil of the helix will furnish its quota of current, and the sum total of effect is much greater than when only a single ring or coil is employed.

For the following experiments, two flat spirals, each formed of covered copper wire, are used.

280. One of the spirals is laid flat upon a table, its two ends being connected with a galvanometer; the other spiral is connected with a voltaic battery, with which the connection can be established or broken at pleasure. Let us call this the *inducing* or *primary* spiral, and that connected with the galvanometer the *secondary* or *induced* spiral.

281. Laying one spiral upon the other, on sending a current through the primary, the needle of the galvanometer is suddenly driven aside by the current induced in the secondary; but the force which acts upon the needle passes away in an instant, the needle returning to its first position.

282. On interrupting the current the needle also receives a shock, being deflected in the opposite direction. It thus declares the existence of a second temporary current in the secondary spiral. The directions of these two currents, with reference to that of the primary, have been already indicated (Note 277).

283. Holding the secondary spiral at a distance from the primary with the current flowing through the latter; on causing the secondary spiral to *approach* the primary, a current is aroused; this current ceases the moment the motion towards the primary ceases.

284. On *withdrawing* the secondary spiral from the primary, a current is also aroused; this current also ceases the moment the motion of withdrawal ends.

285. The current excited by approach is opposed in direction to the primary; the current excited with withdrawal is in the same direction as the primary.

286. Two electric currents flowing in the same direction attract each other; if they flow in opposite directions they repel each other.

287. Hence, to make the secondary spiral approach its primary, we have to overcome a *repulsion*; while to withdraw the secondary from the primary we have to overcome an *attraction*. Thus, in order to produce these induced currents, *we must expend mechanical force.*

288. The force thus expended appears as heat in the secondary wire after the cessation of the induced current. It is the mechanical equivalent of that heat.

289. The approach of a magnetic pole to the secondary spiral and the withdrawal of the pole from the same spiral also arouse induced currents. But, as before, it is only during the periods of approach and withdrawal that the current appears.

290. Thus by tbe mere motion of a magnet, and without any battery or machine, electric currents may be produced.

291. Every change of the magnetic condition of the space near a secondary coil or within it produces an induced current in the coil. If the change be an augmentation of magnetism, the current is in one direction; if it be a diminution of magnetism, the current is in the opposite direction.

292. When a long secondary coil surrounds a primary coil with a core of iron, by breaking and making the circuit of the primary in rapid succession, a series of powerful discharges may be obtained. An automatic apparatus is usually employed to make and break the circuit.

293. Such induction coils have been constructed with great skill by Ruhmkorff, and are, therefore, sometimes called Ruhmkorff's coils. Mr. Apps has recently produced induction coils of astonishing power.

294. The power of a coil depends mainly on the perfection of the insulation of its coils. The induced currents in a Ruhmkorfi's coil may possess thousands of times the electro-motive force of the primary which excites them. They are able, for example, to overleap as sparks distances thousands of times greater than that possible to the primary,

Relation of Induced Currents to the Lines of Magnetic Force.

Rotatory Magnetism.

295. The foregoing phenomena and principles were all laid bare by Faraday. He also established most important relations between his induced currents and the lines of force surrounding a magnet. (See Note 25).

296. He proved that when a conductor moves *along* the lines of force no induced currents appear; but when it moves *across* the lines of force such currents are generated.

297. He proved, for example, that when a metal disk is caused to rotate so as to be tangent to the lines of force, no current appears; while when the disk, in its rotation, *cuts* the lines of force, currents flow along the disk, from the centre to the circumference and from the circumference to the centre. Closed circuits are thus established in the disk.

298. This, in fact, is the "Magnetism of Rotation," discovered by Arago in 1820, which received complete explanation at the hands of Faraday.

299. Faraday showed that the lines of force of terrestrial magnetism suffice to produce induced currents when they are intersected by the rotating disc. In fact, all the effects of magneto-electric induction may be obtained from the magnetism of the earth.

300. When a conductor rotates round an axis which is parallel to the lines of force, it experiences simply the resistance due to the friction of the air; but if the axis of rotation be transverse to the lines of force, the rotation is retarded by the interaction of the magnet and the induced currents.

301. This retardation may become so powerful as instantly to arrest the rotation. If, for example, a cube or sphere of copper suspended from a twisted string be caused to spin, by untwisting, between the poles of an unexcited electro-magnet, it experiences the retardation due to air friction only; but, on the supervention of the magnetic force, the rotation is suddenly arrested. Faraday also showed that in passing a plate of copper rapidly to and fro between the magnetic poles you seem to be cutting cheese, though nothing is visible. It is as if pure space were a kind of solid.

302. If by mechanieal means the conductor be compelled to rotate or to move to and fro between the excited poles, it will be heated. Joule first demonstrated this; but a very striking demonstration of it was given by Foucault, who heated his celebrated gyroscope in this way. The heat is readily rendered sufficiently intense to melt fusible metal. Between the unexcited poles no effect of this kind is produced.

303. The repulsion set up by induced currents between the helices and the moving masses of iron in an electro-magnetic engine, would of itself limit the practical application of electricity as a motive power. Nevertheless, though such engines speedily reach the limit of their action, the conversion of molecular force into mechanical effect may be rendered far more perfect than in the case of the steam-engine.

The Extra Current.

304. If the secondary coil of a Ruhmkorfi's machine have its ends united, the secondary circuit being then complete, the spark obtained in breaking the primary is small. On separating the two ends of the secondary the primary spark is instantly augmented.

305. The diminution of the spark is due to the reaction of the completed secondary circuit upon the primary. When the secondary circuit is interrupted, this reaction ceases.

306. The primary circuit in its turn can, when complete, react upon the secondary. It *is* complete whenever contact is *made* by the automatic contact-breaker. A great enfeeblement of the secondary current is the consequence. When the primary circuit is interrupted, the reaction does not exist; there is no enfeeblement, the full power of the secondary being developed. It is on this account that in Ruhmkorff's coil we obtain discharges *in a single direction* only, instead of discharges alternating in direction.

307. The reaction here referred to connects itself with what is called the *extra-current.*

308. When a current is sent through a single primary coil, the primary current excites in the wire which carries it, a secondary current opposed in direction to the primary. The primary arouses an antagonist in its own path, which, however, immediately disappears.

309. When the primary circuit is broken, a secondary current of momentary duration and having the same direction as the vanishing primary, is evoked in the coil.

310. Each of the two currents evoked *in the primary circuit itself*, at the commencement and at the cessation of the primary current, has been called by Faraday an *extra-current.*

311. The spark obtained on breaking the primary circuit is augmented in brilliancy and power by the extra-current.

312. If a second circuit be associated with the primary; if, for example, two covered wires are wound round the same reel; on making one of them a primary circuit, we have the brilliant spark due to the extra-current, *as long as the ends of the second coil remain unconnected.*

313. But the moment they are connected the extra-current in the primary circuit disappears; there is an instant reduction in the brilliancy of the spark.

314. This is an example of the reaction referred to in

Note 304. By the closing of the secondary circuit the extra-current is formed *in it* instead of in the primary one. Here, in fact, the extra-current becomes an ordinary induced current; it is only so long as it remains in the primary circuit that its distinctive name is applied to it.

(To be continued.)

NOTICES OF BOOKS.

Saggio di un Corso di Fisica Elementare, Proposto alle Scuole Italiane. Da GIOVANNI LUVINI, Professore di Fisica Nella R. Militare Accademia di Torino. Quarta Edizione. Torino: 1868.

WHILE two of the most scientific nations of the world are engaged in a murderous strife, at which humanity shudders and the best intellects recoil, it is pleasant to hear the voice of Science from a land to which Science already owes much, and may look forward to peaceful conquests to which she will owe more. If war developes the manhood and the intellect of a country, it cannot be said to be an unmitigated evil, and there is much to encourage the hope, that Italy, made free and united by means of war, has awakened from the long torpor which lay upon her while she was divided and enslaved. There is hope for a nation when her schools are active, and a treatise on Physics of 750 pages has already reached a fourth edition and is used as a text-book by young Italy.

A few years ago we noticed in these pages the address of the President at the opening of the second session of the College of Chemistry at Naples,* in which the backward condition of Italy, consequent on years of political misrule, was feelingly adverted to, while science was in as deplorable a condition as political liberty. In another critical notice we gave a specimen, on the authority of Melloni, of the kind of scientific teaching permitted under Austrian and Bourbon rule.† Certainly, if the work before us may be taken as an exponent of Italy's progress during the last three years, she has indeed made rapid advances in scientific culture, for this Treatise on Elementary Physics would do honour to any country however advanced.

It must not, however, be forgotten that a nation that lives on the recollection of her former freedom and greatness, and never willingly consents to servitude and oppression, has a wonderful elasticity in recovering her rectitude when the weight of tyranny has once been shaken off. Such is Italy, and now that she is happily free and united, she not only looks back to her former fame, but forward to support and maintain her old renown, Hence, in the treatise before us, the scientific glories of Galileo, Torricelli, Venturi, Volta, Melloni, Matteucci, and a host of others, not forgetting modern workers, are quoted on every opportunity with that honest pride which a man feels when he can say "I too am a countryman of Galileo!"

This frequent reference to Italian *savans* gives a peculiarly national tone to the work, and in many respects increases the interest we feel in it. It is too much to expect that the order of scientific freemasonry will ever be established in which all the labourers in the field of Nature shall regard each other as Brethren; the stronger claims of race will prevail, and the *savan* will always be ready to accept the formula, "My country first—even Science must yield to that." *Patriæ fumus igne alieno luculentior.*

We can best illustrate the national feeling to which we refer by quoting the following passage, in which it seems odd to miss the name of Francis Bacon.

After some remarks on the defects of the peripatetic philosophy, the author says:—"It required all the power of a Leonardo da Vinci, of a Benedetti, and, above all, of a Galileo, to recall the attention of the studious to the methods of observation, experiment, and calculation. From the moment when it came to be generally understood that, in the physical sciences, Truth, rather than Authority, must be the guide, there arose a whole generation of explorers of Nature. A vast variety of new phenomena were discovered, which, by their reciprocal action, corrected, while enlarging, the sphere of observation, thus laying the foundation of productive theories, which, in their turn, being successively corrected and renewed, assisted in the discovery of new facts, having served, and still serving, to colligate things apparently unconnected, thereby facilitating the study, while improving the stature, of the body of science."—*Page* 82.

This pride in her scientific men (from which England is comparatively free) has many advantages. It is not only a stimulus to scientific workers, but it assists scientific work. When, instead of leaving the works of men of genius in dusty oblivion on the shelf, the scientific teacher shows himself to be well acquainted with the scientific literature, at least, of his own country, his class, unconsciously adopting the habits of thought of the teacher, begin to cherish the memory, and to peruse the works, of their countrymen who have enlarged the boundaries of knowledge. The aid thus given to the history of discovery is illustrated, in a remarkable manner, by an extract from Galileo, which we meet with in the work before us at page 285. We had never supposed there was any doubt as to the authorship of Chladni's sound figures, and yet we read that Galileo, while scraping a plate of brass, noticed that the dust on the plate arranged itself in equidistant parallel streaks, and, by varying the notes, the figures also varied. Among the notes produced were two, which, by comparison with a viol, were found to differ by a fifth. Measuring the spaces formed by the dust lines, in the two cases, he found 30 of the one equal to 45 of the other, "quale veramente è la forma che si attribuisce alla diapente."

The treatise before us, in addition to the usual subjects of Physics, contains an outline of the Mechanical Sciences, including Astronomy, of the Atomic Theory, and numerous details which we now include under Chemical Physics. The chapters on Cohesion and Adhesion are remarkably well done. The author is not afraid to question certain received doctrines, and to express his belief that the theory of capillary action, as propounded by Clairaut, La Place, and Poisson, represents some clever applications of the calculus rather than of Nature. His own demonstration of capillary action is neat and clear. He also gives some of the latest details respecting surface tension, and copies the figures of Plateau, Van der Mensbrugghe, and Tomlinson, and gives some new figures of his own.

Thus, while the book is essentially Italian, in consequence of its numerous references to Italian *savans*, past and present, the author, nevertheless, looks out of Italy, and does not forget that there are successful *savans* elsewhere.

But the work has yet other claims to respectful attention. The author does not fall under the reproach, implied in Davy's remark on Berzelius, "He is only a chemist!" Prof. Luvini occasionally indulges in metaphysical subtleties, which are, among other benefits, so far useful, in reminding us of the narrow limits of our powers, that when we seek for a definition of the *matter* on which we work, or of the *mind* by which we work, we are reduced to the humiliating conclusion, that "as matter is the mysterious something which excites the mind to feel, so mind is the mysterious something which feels and thinks."* There is also an occasional touch of sarcasm in what may be called the bye-play of the lecturer, when, as if speaking to himself, or thinking aloud, he remarks—say, in reference to Dutrochet's mysterious epipolic force—"Fine times those, when the creation of a name was deemed equivalent to the exposition of a fact!"—*Page* 226.

We also especially admire the author's love of poetry,

* CHEMICAL NEWS, vol. xv., p. 238.
† *Ibid.*, vol. xv., p. 185.

* See Mill's "Logic," ch. iii., § 8.

which gives a charm to his style and a breadth to his teaching. Such teaching must have the best effect on the young men of his class who come to learn physics (and it must be their own fault if they fail to do so), and while acquiring this knowledge are reminded by various side touches that the literature, the art, and the science of a country are under mutual obligations to each other.

It is difficult to select a passage that will convey an idea of the work as a whole, or even of the author's style, unless it could be given in the beautiful language of the original, for our author, in common with the French *savans*, seems unconsciously to adopt the maxim that scientific teaching is improved by a clear and graceful style: we will, however, venture to translate a passage from the end of the chapter on Chemical Actions.

"We were formerly accustomed to say that the power of the chemist was limited to the artificial formation of inorganic bodies only. The progress of organic chemistry has already swept aside this limitation. But, in truth, all chemical products proceed from the hand of Nature; all that man does is to bring together the elements destined to mutual reaction. Whether we decompose water, oxidise zinc, crystallise sulphur, or fuse gold, we do nothing more than what Nature herself does in bringing about the same results. Is it not by realising the necessary conditions that the gardener produces the immense variety of plants and the grazier the best animals? or, as the poet well expresses it,—

'If in the maw of the serpent the juice is transformed into poison,
Still it becomes sweetest honey when hid in the bag o' the bee.'

"The whole difficulty consists in knowing and being able to dispose of matter in such a manner as to bring about those reactions that lead to the changes we are in search of."—*Page* 262.

The scientific formulæ given in the work are of an elementary character, but sufficient to redeem it from being superficial, which some so-called popular treatises are. We may further remark that the author is himself an original worker, or he could not have produced so excellent a treatise. A translation of a paper by Professor Luvini on the viscosity of liquids will be found in the September number of the *Philosophical Magazine*.

C. T.

Highgate, N., August 25th, 1870.

Heat a Mode of Motion. By John Tyndall, LL.D., F.R.S., &c., Professor of Natural Philosophy in the Royal Institution of Great Britain. Fourth edition. London: Longmans, Green, and Co., 1870.

The very fact of the fourth re-issue of this work is an undeniable proof of the excellence of its contents. The author has bestowed upon this edition additional care, and enriched it with some account of his recent researches on the chemical reactions of light, considered from a dynamical point of view. In the former editions the relations of gaseous matter to the longer waves of the spectrum were developed; in this one the relations of the same form of matter to the shorter waves are also submitted to experimental treatment, the two lines of inquiry being united by the conception of molecular motion, which is common to both. The bearing of some of the results on two of the great questions of meteorology—the Blue Colour of the Sky, and the Polarisation of its Light—is likewise explained and pointed out. The author has also added a hypothesis regarding the Constitution of Comets, and a few remarks on the Polarisation of Heat. This edition is greatly enlarged, its contents are rendered more interesting, and are made complete up to the present date. The eminent author deserves the sincere thanks of all who can appreciate, and we hope very many do, the insight he is gradually acquiring into this department of natural science. As is generally the case with books published by this firm, the work is highly commendable for its typographical execution and excellent engravings and woodcuts.

CORRESPONDENCE.

TEMPERATURE AND HEATING-POWERS OF FLAMES.

To the Editor of the Chemical News.

Sir,—In your last number Professor Wurtz replies to my criticism on the paper of Professors Wurtz and Silliman on the "Calorific Powers or Effects of Gases."

Professor Wurtz first of all charges me with inattention to his paper, and with confusion of ideas—in suggesting that by the term "heating effect of a gas," he really means the "flame-temperature"—and then, in the last paragraph, acknowledges that the numbers given in my note (which are calculated flame-temperatures), are precisely what he has designated as calorific powers or effects. The term "calorific power" is a term in common use, and to be carefully distinguished from "calorific intensity," which is synonymous with "flame-temperature." Professor Wurtz certainly uses the term "calorific effect" for the numbers calculated by Bunsen's formulæ, which are really the theoretical flame-temperatures, whereas "calorific power" has always been used to mean the quantity of heat produced by the combustion of a given weight of the substance. It is used in this sense by Percy in his "Metallurgy," and indeed is employed in that sense by Professor Wurtz himself in part of his paper.

But the real point at issue between us is not a question of terms at all, but of facts, and in order that this may be clearly understood, I must beg permission to quote from the original paper somewhat at length. Professors Silliman and Wurtz write:—

"The admirable researches of the great gas-chemist, Bunsen, of Heidelberg, placed in our possession, some years ago, the means of computing, at least with approximate accuracy, the heat of flames of gases of known compositions. Few, however, have properly and successfully applied Bunsen's method in practice. We consider it quite time that these methods should be introduced to the knowledge of gas-engineers, in forms available to them.

"Bunsen's *formulæ* for these computations are based upon the actual experimental determinations of the *total* amounts of heat developed by the combustion of different pure combustible gases with pure oxygen made by Favre and Silbermann, and upon Regnault's determinations of the specific heats of gaseous products of combustion.

"It is not to be maintained that Favre and Silbermann's numbers are strictly correct, but they are doubtless approximate, and at least proportionately correct among themselves; at any rate, they are the best data we have. Those employed here are included in the following table. They are usually given in the text-books for equal *weights* of the gases; but we have reduced them to the standard of equal *volumes* also, as more suitable to our present purpose. This reduction is made simply by multiplying the equivalents for weights by the densities as given in the third column.

Table I.

	Total caloric equivalents		
	Of equal weights.	Of equal volume.	Densities on scale of dydrogen = 1.
Carbonic oxide	34,462° C.	34,462° C.	1·0
Hydrogen ..	2,403° ,,	33,642° ,,	14·0
Marsh gas ..	13,063° ,,	104,504° ,,	8·0
Olefiant gas ..	11,858° ,,	166,012° ,,	14·0

"The meaning of this table is simply that equal weights of water would be heated by the several gases to temperatures proportional to the numbers in the first column when equal *weights* of the gases are burned, and propor-

tional to those in the second column when equal *volumes* are burned.

"A cursory glance at the figures in the second column of this table might seem to justify the notion hitherto entertained by many of the comparatively low calorific powers of hydrogen and carbonic oxide; and it was doubtless as a consequence of such a comparison as this that statements have been put forth and widely accepted among American gas-engineers to the effect that the weight of water heated from the freezing to the boiling-point by 1 cubic foot of the four main components of illuminating-gas, respectively, is as follows:—

Hydrogen	2·22 lbs. water
Carbonic oxide	2·16 ,,
Marsh gas	6·17 ,,
Olefiant gas	10·74 ,,

"The figures here being obviously about in the same ratio as those in the second column of Table I. Several most grave errors, however, are here involved. To get at the true relative calorific effects of the above gases, when burned in the open air, in heating water below its boiling-point, deductions must be made, not only for the *specific heats* of the products of combustion of the gas, but also (more important still) for the specific heat of the *nitrogen of the air* required to burn the gas. In fact, when we consider that, for each volume of oxygen required to burn a given volume of a gas, about *four volumes* of nitrogen must be heated up to the temperature of the flame, it becomes easy to conceive, what is actually the fact, that, within certain limits, the waste of heat due to this cause alone counterbalances altogether the advantage that would be supposed to result from the crowding of combustible matter into so condensed a form as in the illuminating hydrocarbons. An inevitable result of our investigations of this matter is that the heating powers of the flames of pure hydrogen and pure olefiant gas, even when used to the greatest advantage, to heat water below its boiling-point are almost or quite identical."

Now, I venture to assert that the numbers just quoted, in which, according to Professor Wurtz, "several most grave errors are involved," are substantially correct—that the specific heats of the products of combustion and of the nitrogen of the air required to burn a gas have nothing whatever to do with the maximum calorific effect of the gas, and that, instead of the powers of the flames of hydrogen and olefiant gas to heat water below its boiling point being identical, olefiant gas will be always nearly five times as effective as the same volume of hydrogen burnt under the same circumstances.

Professor Wurtz admits the justice of my objection to his statement that the heating effect of olefiant gas is ever lower than that of carbonic oxide, if the combustion take place in pure oxygen, but affirms that it has no force if the combustion take place in air.

I must plead guilty to want of precision in not clearly stating that I was speaking of combustion in air (my statement that the flame-temperature of carbonic oxide is higher than that of olefiant gas is not even true if the combustion take place in pure oxygen), and in not pointing out that the reason why the flame of olefiant gas in air is colder than that of carbonic oxide in air, although the quantity of heat produced by its combustion is so much greater, is not only the latent heat and the high specific heat of the steam produced in the former case, but also the larger quantity of nitrogen, which is one of the products of combustion. But, surely, whatever the products of combustion are, when they are made to give up their heat to water they must give out exactly the same quantity of heat which was required to raise them to the temperature which they possessed; and, thus, the effect of a gas in heating water will be the same, whether it be burnt in oxygen or in air, and will be correctly measured by the calorific equivalent (of equal volumes) given in the table quoted above. The number for olefiant gas being nearly five times that for hydrogen, my statement is justified that the flame of olefiant gas is nearly four times as efficient in heating water below 100° as the flame of hydrogen. Professor Wurtz may object that this is true only if the products of combustion give up all their heat and escape themselves at a temperature of 0° C., which is, of course, impossible. The following results of calculation show that if the products of combustion escape at a temperature above 100° C., olefiant gas is even more than five times as efficient as the same volume of hydrogen.

The combustion in air of	Will raise from 0° to 100° C.	If the products of combustion escape at the temperature
1 lb. hydrogen ..	344·62 lbs. water	.. 0° C.
14 lbs. olefiant gas..	1660·012 ,,	.. 0° C.
1 lb. hydrogen ..	329·1 ,,	.. 100° C.
14 lbs. olefiant gas..	1593·7 ,,	.. 100° C.
1 lb. hydrogen ..	184·17 ,,	.. 1000° C.
14 lbs. olefiant gas..	984·16 ,,	.. 1000° C.

—I am, &c.,

W. MARSHALL WATTS.

Manchester Grammar School,
Aug. 29th, 1870.

MISCELLANEOUS.

Recent Chemical Appointments. — Mr. T. E. Thorpe, Ph.D., of Manchester, has been elected Professor of Scientific Chemistry at Anderson's University in the room of the late Professor Penny. Dr. Thorpe has for some time held the post of Junior Assistant in the Chemical Laboratory at Owen's College, where his talents and zeal have been fully appreciated. Dr. Debus, F.R.S., has been appointed to succeed Dr. Alfred Swaine Taylor, F.R.S., as Professor of Chemistry at Guy's Hospital Medical School. Dr. Debus is succeeded, as Lecturer on Natural Science at Clifton College, by Mr. G. Farrer Rodwell, F.C.S., whose originality of thought and powers of description, combined with his high scientific attainments, well qualify him for the appointment.

University of London.—The following are lists of the candidates who have passed the recent M.B. and B.Sc. examinations:—*First M.B. Examination (Examination for Honours).*—Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry: First Class. Chas. Atkinson Nankivell, Exhibition and Gold Medal, University College; William Smith Greenfield, University College, and Ebenezer Geer Russell, Guy's Hospital (equal); George Birt, Sydenham College, Birmingham. Second Class. Sidney Coupland, University College; Henry James Benham, University College. *First B.Sc. and Preliminary M.B. conjointly).*—Chemistry: Second Class. Henry Hetley, Prel. Sci., Guy's Hospital; P. Herbert Carpenter, First B.Sc. and Prel. Sci., University College and Royal School of Mines. Third Class. F. John Morton Palmer, Prel. Sci., Guy's Hospital, and Ernest William White, Prel. Sci., King's College (equal); Eugène Crétin, Prel. Sci., St. Bartholomew's Hospital, and Thomas King Rogers, Prel. Sci., University College (equal); H. Joseph Firth Groves, Prel. Sci., Guy's Hospital. Experimental Physics: Second class. John Landor Lowe, First B.Sc., King's College.

British Association for the Advancement of Science.—The following is the programme of the arrangements for the fortieth annual meeting of the British Association for the Advancement of Science, to be held in Liverpool, commencing on Wednesday, the 14th inst. President-elect—Professor Huxley, LL.D., F.R.S. Vice-Presidents-elect—The Right. Hon. the Earl of Derby; Right. Hon. W. E. Gladstone, M.P., D.C.L. Sir Philip G. Egerton, Bart., M.P., F.R.S.; Sir Joseph Whitworth, Bart., LL.D., F.R.S.; S. R. Graves, Esq., M.P.; J. P. Joule, Esq., LL.D., F.R.S.; Joseph Mayer, Esq.,

F.S.A. Chairman of Local Executive Committee—The Mayor of Liverpool (Joseph Hubback, Esq.) Local Treasurer—Henry Duckworth, Esq., F.G.S. The sections are :—A—*Mathematical and Physical Science* (in the Crown Court, St. George's Hall): President—J. Clerk Maxwell, F.R.S.L. and E.; Secretaries—Prof. W. G. Adams; W. K. Clifford; Prof. G. C. Foster, F.R.S.; Rev. W. Allen Whitworth. B—*Chemical Science* (in the Royal Institution, Moore Street): President: Prof. Henry E. Roscoe, PhD., F.R.S., F.C.S.; Secretaries—Prof. A. Crum Brown, F.R.S.E., F.C.S.; A. E. Fletcher, F.C.S.; Dr. W. J. Russell, F.C.S. C—*Geology* (in the Concert Hall, Lord Nelson Street): President—Sir Philip de Malpas Grey Egerton, Bart., M.P., F.R.S., F.G.S; Secretaries—W. Pengelly, F.R.S., F.G.S.; Rev. H. H. Winwood, F.G.S.; W. Boyd Dawkins, F.R.S., F.G.S.; G. H. Morton, F.G.S. D—*Biology* (in the Reading Room and Lecture Room of the Free Public Library): President—Prof. G. Rolleston, M.D., F.R.S., F.L.S.; Vice-Presidents—John Evans, F.R.S., F.G.S., F.S.A.; Prof. Michael Foster, M.D., F.L.S.; Secretaries—Dr. T. S. Cobbold, F.R.S., F.L.S.; Thos. J. Moore; H. T. Stainton, F.R.S., F.L.S., F.G.S.; Rev. H. B. Tristram, LL.D., F.R.S. E—*Geography* (in the Small Concert Room, St. George's Hall): President—Sir Roderick I. Murchison, Bart., K.C.B., D.C.L., LL.D., F.R.S., F.G.S.; Secretaries—H. W. Bates, Assist. Sec. R.G.S.; Clements R. Markham, F.R.G.S.; Albert J. Mott; J. H. Thomas, F.R.G.S. F—*Economic Science and Statistics* (in the Council Chamber, Town Hall): President—Prof. Jevons; Secretaries—E. Macrory; J. Miles Moss. G—*Mechanical Science* (in the Civil Court, St. George's Hall): President—Charles Vignoles, C.E., F.R.S., M.R.I.A., F.R.A.S.; Secretaries—P. Le Neve Foster; J. T. King. General and Evening Meetings—Wednesday, Sept. 14: The first general meeting will be held in the Philharmonic Hall, at 8 p.m., when Professor Stokes, M.A., D.C.L., will resign the chair, and Professor Huxley, LL.D., F.R.S., will assume the Presidency and deliver an address. Thursday, Sept. 15: The Mayor's First Reception at the Town Hall. Friday, Sept. 16: Lecture in Philharmonic Hall, at 8.30 p.m., by Professor Tyndall, LL.D.; the Mayor's Second Reception at the Town Hall. Saturday, Sept. 17: Address to Working Men, in Concert Hall, Lord Nelson Street, at 8 p.m., by Sir John Lubbock, Bart., M.P., F.R.S. Monday, Sept. 19: Lecture in Philharmonic Hall, at 8.30 p.m., by Professor Rankine, LL.D., F.R.S. Tuesday, Sept. 20: Soirée in St. George's Hall, at 8 p.m. Wednesday, Sept. 21: Concert in St. George's Hall, at 8 p.m. Thursday, Sept. 22: Excursions to several places. Members requiring Railway Pass Tickets and further information should apply to any of the following Hon. Local Secretaries—Wm. Banister, B.A.; Reg. Harrison, F.R.C.S.; H. H. Higgins, M.A.; A. Hume, D.C.L., LL.D., Municipal Buildings, Dale Street, Liverpool.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 22, 1870.

This number does not contain any papers or memoirs relating to chemistry, but, among the few published relating to physical sciences, we notice—

Note on the First Session of the International Committee of the Metrical System, which met at Paris from the 8th to the 13th of August last.—General Morin.—We learn from this paper that twenty out of the twenty-five States which accepted the invitation were represented at this meeting; these States are—The Austro-Hungarian Empire, Chili, Columbia, Spain, Papal States, United States of America, Republic of Ecuador, United Kingdom of Great Britain and Ireland, Greece, Italy, Nicaragua, Peru, Portugal, Russia, San Salvador, Sweden and Norway, Switzerland, and Turkey. The meeting has appointed—President, M. Matthieu. Vice Presidents—M. Struve, of St. Petersburgh; Dr. W. A. Miller, London; M. Henry, Secretary of the Smithsonian Institution, Washington, U.S.; M. Herr, Vienna; General Morin. Secretaries—M. Tresca, Paris, and M. Hirsch, Neufchâtel, Switzerland. The Committee, having fixed upon the programme of their labours, and having appointed sub-committees, has adjourned its meetings *sine die*.

Phenomenon of Choc en Retour observed at Porto-Alegre (Brazil).—M. Laranja Oliveira.—The author writes—One of my servants had to walk home, in the early part of last June, during a violent thunderstorm. When at about 100 metres' from my residence, in the outskirts of this town, and just when a violent flash of lightning appeared, he felt suddenly as if his body was everywhere pricked with needles, his feet were temporarily lamed, and the hair of his head raised upright to such an extent as to oblige him to hold his hat with his hands to prevent it from falling off; close to him (at about 2 metres' distance) he saw, near to the ground, a whitish smoke, which emitted flashes of vivid lightning, it being about midnight. After having recovered, and arrived home, he discovered that a key he happened to have had in his pocket had become strongly magnetic.

August Meteorites of this Year.—M. Chapelas-Coulvier-Gravier.—The author states that this year is exceptional, as regards the scarcity of meteorites seen generally; he next enumerates some of the causes which co-operate to render the observation of the meteorites more difficult, as there are, for instance, cloudy sky and strong moonlight; lastly, the author gives the names of the constellations wherein most of these luminous meteors have been seen during the month above named.

Moniteur Scientifique, No. 328, August 15, 1870.

This number does not contain any original memoirs or papers, but we quote the following from the *brevets d'invention*:—

Improvements in the Manufacture of Animal Charcoal.—MM. Pilon and Co., Paris.—This improvement simply consists in the granulating of the bones previous to their calcination, the result being that the quantity of dust and small (useless for the purposes of the sugar refiner, and of inferior value for agricultural purposes) is very considerably lessened. The bones, of course, have been first boiled, and the fat extracted by proper means.

Manufacture of Sal-Ammoniac Combined with the Production of Peroxide of Manganese.—L. J. Martin.—Of the residues of the manufacture of chlorine, 600 kilos. are mixed with 100 kilos. of ammonia (sp. gr., 0·924). This magma is first somewhat evaporated; and, after the clear liquid has been decanted, it is evaporated to dryness, and then sublimed, while the manganese is slowly peroxidised. The editor of the above-named periodical very properly observes that, although, in theory, such a process might answer, it is, even with small quantities, not of any practical utility.

Girondin Disinfectant.—G. Vigué.—The author mixes, but does not say in what quantities, sulphate of zinc, acetate of copper, carbolic acid, and crystals and essence (*sic*) of baryta, to be together dissolved in water. No explanation is given as to what essence of baryta means.

Manufacture of Steel Types for Typographical Use.—G. Bauer.—By an ingenious mechanical contrivance, not unlike that in use for making nails, the author converts previously-softened steel wire into types which are afterwards hardened. With a single machine, and a 1-H.P. steam-engine, 35,000 types can be made in twelve hours, while the types thus made are of a superior finish, and cheaper also, on account of the less expense of the steel as compared with the ordinary type metal (usually an alloy of antimony and lead, in the proportion of 1 part of antimony to 4 of lead, with a very small quantity of copper, the latter being usually present in sufficient quantity in what is termed hard lead).

As a curiosity, we mention the following:—

Pomatum for Softening and Whitening the Skin.—H. Freymond.—The author has taken a *brevet d'invention* for a mixture of olive oil, lavender essence, white wax, oil of turpentine, mutton suet, and common carmine. This would, no doubt, do very well for French polish, but the oil of turpentine would render it highly unpleasant, to say the least of it, to those who should apply it to their skin, and especially lips.

Les Mondes, August 18, 1870.

Soluble Vegetable Tar (Sacharolé de Goudron).—A. Roussin.—The author states that he has succeeded in obtaining, by the use of pure sugar, a very useful pharmaceutical preparation to supersede the use of tar-water as made and applied from what is termed in this country Stockholm tar. The preparation is a powder of constant composition, and containing 4 per cent of the real active principles of the tar-water of the Pharmacopœia; it is highly spoken of by M. Gay, a very well known pharmaceutist, and Director of the pharmaceutical school at Montpellier.

Toselli's Dynamical Refrigerator.—The author describes, and illustrates with woodcuts, a contrivance consisting mainly of a tube wound round a central axis, and movable in a trough partly filled with water, and not unlike the trough in use for grindstones. By the rapid motion of the tube through the water, that fluid enters the tube; while the water which is outside of it evaporates rapidly, and, by that evaporation, causes the cooling of the water inside, which, by the developed centrifugal force, is carried through the windings of the tube, and thus affords means for obtaining a supply of comparatively cold water. The author has found, by experiment, that, even when the initial temperature of the water is 36°, it may be cooled down to 18·5°; and when a ventilator is simultaneously used, so as to produce a strong current of air upon the convolutions of the tube, and thus accelerate the evaporation, the cooling effect is greatly increased. The speed to be given to the metallic tube is very moderate.

August 25, 1870.

Useful Applications of the Electric Light.—F. E. Pâris.—This lengthy paper chiefly treats of the application of the electric light to lighthouses, as signal-lamps on board ships, and also for affording light to narrow channels near the mouth of rivers, and for rendering approach to harbours possible during the night time. The author has experimented with various magneto-electric machines, and gives, in detail, the requisite instructions for the management of electric lights for the purposes above alluded to.

Silver Mine of Potosi.—This mine, situated in the Andes of Peru, is considered the highest mine wrought in the world, as regards its elevation above sea level, which is 3465 metres; while the deepest mine under the sea level is the salt mine of Neusalzwerk (Westphalia), which is 625 metres below the sea.

Composition of Chinese Lacquer-Work.—Dr. Wiederhold.—According to the author, genuine Chinese lacquer-work is done over tin-foil, and consists of a mixture of 2 parts of copal and 1 of shellac, molten together. When fluid, there are added 2 parts of boiled linseed oil; and, after the vessel containing this mixture has been taken from the fire, there are gradually added 10 parts of oil of turpentine. If colour is required, gummi-gutta, dissolved in oil of turpentine, yields yellow, and dragon's blood, dissolved in the same liquid, yields red.

Artificial Ice.—M. Toselli.—The author, writing to the editor of the above-named periodical, states that actual experience has proved that the ice made by the process invented by him withstands the influence of a temperature far above the freezing-point of water better than natural ice, or than any other ice obtained by artificial means; and to illustrate this fact, the instance, properly proved, is brought forward, that a block of ice weighing 20 kilos., made by the author's process in eighteen minutes, and sent off from Paris to Algiers on the 30th of June last, arrived, properly packed, at its destination late in the afternoon of the 5th of July, and the block of ice then remaining still weighed 10 kilos. The loss, by fusion, on a journey through a warm climate in the middle of summer was, therefore, only 84 grms. per hour. 100 kilos. of ice made by the author's process would require, under the same conditions of temperature, 49¼ days to liquefy it; whereas 100 kilos. of the ice artificially made by the process of M. Tellier, has been found to melt in six days under the same conditions. It appears that M. Toselli's apparatus renders ice very compact.

Journal de Pharmacie et de Chimie, August, 1870.

This number contains the following original papers and essays:—

New Process for the Quantitative Estimation of the Alkaloids of the Cinchona and Calisaya Barks.—P. Carles.—The author begins with giving a review of the different methods hitherto in use for the quantitative estimation of the alkaloids alluded to, which methods may be divided into two main classes—viz., those by which the whole of the alkaloids are estimated together, and those by which only the quinine is estimated. The author's new method is the following:—A fair average sample of the bark to be tested is ground up to a fine powder, and sifted, but any residue left on the sieve is to be pulverised again. 20 grms. of this powder are taken and intimately mixed, in a mortar, with 8 grms. of quick-lime, slaked, just previous to use, with 35 grms. of water. The pasty mass thus obtained is dried on a water-bath. As soon as the mixture has become dry enough to be broken up into small lumps, this is done, and the lumps placed in a funnel-shaped tube, the lower and narrower opening of which is closed by a plug of cotton wool. Chloroform is poured over the mass, a quantity of 150 grms. being sufficient, and the last traces of that fluid are washed off with some distilled water; the larger portion of the chloroform is either evaporated or (as may suit the operator) distilled off on a water-bath, and the residue taken up with from 10 to 12 c.c. of dilute sulphuric acid (1 of acid to 10 of water). This solution is poured on to a previously well-moistened filter, which retains the resinous matters, while a clear liquid runs off. The filtrate is boiled, and, when in full ebullition, ammonia is added to it, so as to leave only a slightly acid reaction; all the sulphate of quinine crystallises out, while the mother-liquor retains the rest of the alkaloids, which may be separated by precipitation and further tested. The author has added to his paper some tabulated results of experiments made by him with the same quantity of bark, and operating with various methods executed carefully, as described by the original authors and suggestors of these methods, in order thus to prove the superiority of his method.

Soluble Iodide of Starch, and its Decolouration by Heat.—A. Petit.—This paper treats on the proper method of preparing a pharmaceutical compound and a syrup of iodide of starch, and on the hanges these mixtures undergo by the action of heat. It appears that the cause of the well-known decolouration of iodide of starch by the application of heat is due to the complete solubility of that compound at a high temperature, and the temporary destruction of the combination existing at a lower temperature between starch and iodine.

Heat Set Free by the Mixing of Two Liquids.—M. Berthelot.—A letter to M. Buesy, only containing a series of algebraic formulæ.

Basic and Neutral Bromhydrates of Quinine and Cinchonine.—M. Latour.—The author describes the preparation, for pharmaceutical purposes, of compounds made up of bromide of potassium and sulphate of quinine. Some of these salts so obtained are really chemical combinations which, in their general characters, do not differ from chlorhydrates of quinine.

Experimental Researches on Gold and its Compounds.—J. P. Prat.—The main results of the author's experiments are—That nitro-muriatic acid chlorurises gold in various degrees, and that this depends upon the composition of the acid, the quantity which is applied in reference to the gold, and the degree of heat; that pure gold can be readily and rapidly prepared and obtained in spongy state; that gold can be directly oxidised and salified by oxacids; that there exists a liquid and volatile chloride of gold containing more chlorine than the sesquichloride; that there exists, likewise, a sesquiiodide and a carbonate of gold; that there exist two oxides of gold capable of giving a new series of salts; and, lastly, that gold behaves in many instances like some of the other metals.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 5, 1870.

This number contains the following papers and memoirs relating to physico-chemical and collateral sciences:—

On the Landen Sandstone.—J. Moreau.

Determination of the Declination and Inclination of the Magnetic Needle at Brussels in 1870.—A. Quetelet.—A series of tabulated results.

Note on the so-called Natural Pits (Puits Naturels) of the Coal Measures.—MM. Cornet and Briart.—The description of certain hollow and deep faults also met with in some of the cretaceous formations, especially the *Maestricht tufa*, and known locally as geological organs.

Determination of the Exact Latitude of the Tower of the Antwerp Church of Nôtre-Dame.—A. Boë.—The author has determined this latitude by astronomical observations, and the result arrived at is, that the north latitude of the building alluded to is 51° 13′ 14″ 98, a figure only differing by 2-100ths from that obtained nearly sixty years ago, by M. Krayenhoff, by geodesical measurement.

Revue Universelle des Mines, de la Métallurgie, et des Travaux Publics de Belgique, No. 3, 1870.

This number contains only the following original papers relating to physico-chemical and collateral sciences:—

Motion of Permanent Gases through Pipes and Tubes.—Dr. Grashof. And—

Agglomeration of Fuel.—A. Habets.—Both papers being continuations of the portions published in previous numbers of this periodical.

Cosmos, August 20, 1870.

Lavoisier Medal.—Upon the report and proposition of M. A. Payen, this medal has this year been granted to M. H. Sainte-Claire Deville, in consequence of the great number of useful researches made by that *savant* in chemistry, and the application these researches have received in practice. Among the subjects enumerated are—Researches on platinum; the industrial manufacture of sodium; the discovery of the hydraulicity of magnesia; the researches on the application of dead and other heavy hydrocarbon oils as fuel for steam-boilers; the dissociation of bodies by heat.

Cause of the Fires of Pine Forests.—F. Schrader.—The author very ingeniously observes that the cause of the very frequent fires of pine forests, in summer time only (large tracts of country in the Departements des Landes and de la Gironde are covered for miles and miles' distance with such forest, and remote from any habitations), is not due, as has been often surmised, to wilful arson or accidental imprudence, but is produced by the action of the concentration of the sun's ray's upon the hollow globules of resin which exude from the trees, acting as burning lenses, and becoming inflamed; thus causing the combustion to begin, and, once begun, to spread rapidly, in consequence of the highly inflammable nature of the resinous and turpentine-containing wood.

The Part Gaseous Substances Play in Volcanic Eruptions.—J. Delanoue.—The main point of interest contained in this lengthy paper is, that hydrogen gas plays the chief part in the volcanic eruptive phenomena.

Man of the Tertiary Period.—M. Raulin.—The author states that, until the contrary be proved, he thinks that, just as there have been in the five successive faunas, five distinct species of rhinoceros, so the genus *Homo* may have been represented in each succeeding

fauna by species which become gradually more intelligent than their predecessors had been.

Draining of the Dombes, and their Conversion into Fertile Fields.—M. Givord.—By Dombes is understood a portion of the Département de l'Ain, comprising a surface of 90,000 hectares, situated between the rivers Rhone and Saone. In the 13th century this country was a most fertile plain, but about that time the inhabitants, for some reason or other, not specified, commenced making pools of water, now covering 14,000 hectares (the likelihood is that, as is the case in some parts of Holland, peat has been dug, and, by this process, shallow lakes of great surface have been formed); and, as a consequence, malaria spread among the inhabitants, causing, according to the author, such ravages as to sweep away even towns which once had 4000 inhabitants, to reduce the average duration of human life to twenty-one years (only half that of the rest of France), and to impoverish the scanty population. The author enters into details as to the draining of the pools alluded to, but his chief aim is to prove how the work of man may influence his own physical, as well as mental, well-being, and how necessary it is to carry out the drainage of this region.

International Conference on the Prototype Metre.—Dr. O. Struve, Director of the Observatory of the Pulkowa; M. Wilde, Director of the Physical Observatory and Museum at St. Petersburg; and M. Mohn, the Director of the Meteorological Institute of Christiania, have arrived in Paris, for the purpose of taking part in the international conference on the metre and the metrical system generally.

August 27, 1870.

Luminous Phenomenon.—Dr. Roussille.—The author states that, while making a geologico-botanical excursion on the Mount Pilat (Cévennes, France), on the 19th of July last, at sunrise (the temperature being 10·5°, the height above sea level 1288 metres, sky cloudy, and haziness prevailing, with a westerly wind), he suddenly saw the whole sky, as it were, in a fiery glow, the sun orange-coloured, and, looking to the westward, he saw the image of the mountain he was ascending crowned with two rainbows, placed one above the other, and separated from each other by a greyish band, while the rainbows, instead of the seven, only exhibited two colours. The clouds, continuing to move, soon came near to the author, who then distinctly observed his own image. In fact, what he observed and describes is very akin to the well-known Brocken spectrum of the Hartz Mountains, but with this distinction—that the phenomenon seen by the author of this brief notice has never been before noticed in the Cévennes.

Reagent for Detecting Ammonia in Lighting Gas.—V. Meunier—The author prepares a sulphurico-alcoholic tincture of the fresh leaves of the *Coleus Verschaffelti*, by infusing these leaves with absolute alcohol, to which a few drops of sulphuric acid are added. Strips of Swedish filtering-paper are dyed with this tincture, and, after having been dried in open air, are kept in well-stoppered bottles. When required for use, this paper is slightly moistened, and, being tinged green by alkalies, even if only mere traces thereof are present, is a valuable test for ascertaining, according to the author's experience, the presence of ammonia in gas, by only holding a strip of this paper for a moment in a current of illuminating gas.

Fertility of the Soil of Corsica.—J. Casanova.—The author states that, notwithstanding the long-continued and exceptionally-severe drought, and without having applied to his fields any other than a light dressing of stable manure, he has reaped 416 decalitres of wheat per hectare, the straw being, moreover, of exceedingly good quality, and exceeding 1·6 metres in height. This amounts to about 114·4 bushels (English measure) to rather more than 2 acres' surface. It should be observed that the Island of Corsica, as well as the adjacent Island of Sardinia (Italian territory), are both in a highly backward state as regards agriculture, and, moreover, only a very small area of these countries is under tillage.

Revue Hebdomadaire de Chimie, July 28, 1870.

Estimation of Glucose in Commercial Sugars.—J. Midy.—The author prepares a Fehling test-liquor of such a strength that 100 c.c. thereof are completely decomposed by 1·05 grms. of uncrystallisable sugar (1 c.c. of the liquor agrees, therefore, with 0·0105 of glucose); a solution is also made of 20 grms. of the sugar to be tested in 150 c.c. of distilled water. To this solution, previously heated till near its boiling-point, is added, by means of a Mohr's burette (divided into 1-10th c.c.), ½ c.c. of the Fehling cupreous liquor; the sugar solution is withdrawn from the source of heat, and, after having been stirred up, the suboxide of copper, if any has been formed, is allowed to settle. When this has taken place, a very small portion of the liquid is filtered through Swedish filtering paper, and to the filtrate is added a drop of a concentrated solution of ferrocyanide of potassium and acetic acid. If too much of the cupreous test-liquor has been added, the addition of the reagents alluded to will have the effect of causing the formation of the well-known precipitate of ferrocyanide of copper; and, in that case, a fresh sugar solution has to be made, and only ¼ c.c. of the cupreous test-liquor has to be added; and the ferrocyanide should not give indications of excess of copper in the filtered liquid as above alluded to. Such being the case, the operator knows that 20 grms. of sugar contain less than 0·0052, and more than 0·0026, of glucose; taking the average of these figures, which is 0·0039, and multiplying by 5, we learn that the sample of sugar tested contains about 0·0195 per cent of glucose.

Plastic Material of Great Resistance Suitable for a Variety of Uses.—M. Rost.—The author mixes litharge and glycerine, in such proportions as may suit the purpose, so that it may form a creamy liquid or a pasty mass. The mixture becomes, in a short time, a hard, homogeneous mass, which readily adheres to metals, resists the action of water and steam, and a temperature of 275°. In many instances, this paste is preferable and very superior to red-lead cement (linseed oil and red-lead); and this glycerine-litharge paste may be even used, when in very fluid state, for galvano-plastic copying, since the material preserves even fine engraved lines.

August 4th, 1870.

Naphthylamine Violet.—M. Scheurer.—This preparation, consisting of chlorhydrate of naphthylamine and chloride of copper, properly thickened, yields, at the ordinary temperature of the air, and after a few days of ageing, a dull, but pure violet; but, if the temperature of the ageing-room be about 30°, and much moisture present, the operation is finished within thirty-six hours, but the colour is bad and requires a clearing. The author, while experimenting found that, in order to obtain a good violet, the simultaneous action of hydrochloric and acetic acids are required, the latter producing, it appears, a peculiar, but not well explained, reaction.

Drying of Woollen Fabrics.—P. Havrez.—The author states that the complete drying of woollen fabrics is difficult, useless, and injurious to the fibre—difficult, because wool and woollen fabrics attract and retain readily up to 10 per cent of moisture, which should be left in it; useless, because the wool cannot be carded unless moistened and oiled; and injurious, because too strongly-dried wool, as well as woollen fabrics (though in a less degree), become rough and lose suppleness. The author enters, at great length, into the various methods proposed for drying wool and woollen fabrics during the process of manufacture, and describes the stoves and drying-rooms to be used.

Revue des Cours Scientifiques de la France et de l'Etranger, August 6, 1870.

This number does not contain any papers relating to chemistry or sciences allied therewith, but contains an exhaustive and excellent lecture on—

Natural Selection and the Origin of Man—Dr. Claparède—And a lecture on the—

Mechanism of Flying of Birds and Insects.—Dr. Marey.—Illustrated by a series of woodcuts.

August 13, 1870.

This number does not contain any original papers relating to chemistry or sciences allied therewith, but it contains a most valuable paper on the—

Value of the Labours of Charles Darwin.—By no less an authority than the celebrated zoologist, M. Milne-Edwards. And also a paper on—

Commensalism in the Animal Kingdom—M. van Beneden—Wherein the author sets forth several interesting particulars about a very well-known article—viz., sponge—which is a polypous animal reduced to its most simple form; while, chemically, it is a substance very akin to silk—that is to say, a nitrogenous, albuminous compound, almost identical with the fibrine which constitutes more than half the weight of raw silk.

NOTES AND QUERIES.

Analyses of Old Yellow Metal.—Will some of your kind correspondents favour me with the analysis of some samples of old yellow metal taken from ships *(Muntz)*, no matter by what maker, but stating, as near as possible, the period during which it had been on the ship, and to what ports the ship had been trading during that period. The information is wanted as accurate as possible, but especially the quantities of copper and spelter. If you will kindly oblige me with this information, through your columns, you will confer a great favour on a very old subscriber.—Copper. PS. The metal must be thoroughly worn out.

TO CORRESPONDENTS.

*** The Student's Number of the Chemical News will be published on Friday next, September 9th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

A. Hedley.—Forwarded.

R. Galloway.—We are obliged for your kindness.

F. M. Rimmington.—The article will be concluded as soon as possible.

Dr. J. Muter.—Received.

H. N. Draper.—Thanks for your communication; it arrived too late for this week.

THE CHEMICAL NEWS.

Vol. XXII. No. 563.

(STUDENTS' NUMBER.)

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 4th, 1871, and includes the following subjects:—

Natural Philosophy.*

Mechanics.—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*):—Ratio of the Power to the Weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Acoustics—

Nature of Sound.

Mode and Rate of Propagation of Sound.

Musical Tones.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

Chemistry.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General Nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame. Nature and Composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen. Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

* The knowledge required of these subjects in Natural Philosophy is such as may be attained by attending a course of experimental lectures.

Bachelor of Science (B.Sc.).

This Degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

First B.Sc. Examination.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination will commence on Monday, July 18th, 1871. It is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *vivâ voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects:—

Natural Philosophy.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-electric machines.

Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and Properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and Properties of Cast-Iron. Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony. Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic Elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examination, a knowledge of Inorganic Chemistry only is necessary.

EXAMINATION FOR HONOURS.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

SECOND B.Sc. EXAMINATION.

This Examination commences on Monday, October 24th. Candidates for this Examination who have not previously taken the Degree of B.A. is required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its derivatives. Ammonium and Ammoniacal Salts. Amides and Amines; their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumen, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical Principles of the process of Nutrition and of Respiration in Plants and Animals.

EXAMINATION FOR HONOURS.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

DOCTOR OF SCIENCE (D.Sc.).

This Examination is held within the first twenty-one days in June, and occupies four days.

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

* It must be understood that the candidate for the Degree of D.Sc. is expected to be so fully conversant with the principal subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Dean.—Professor A. W. Williamson, Ph.D., F.R.S.

Vice-Dean.—Professor G. Croom Robertson, M.A.

Inaugural Lecture, on Tuesday, October 4th, at 3 p.m., by Professor Williamson.

The Session begins on Tuesday, the 4th of October, and ends on Friday, the 23rd of June.

It is divided into three terms, as follows: Michaelmas term, from October 4th until December 21st; Lent term, from January 3rd, 1871, till March 18th; Summer term, for Lectures, from March 20th till June 10th, all inclusive.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

A. GENERAL COURSE.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £6 6s.; for a Half Course, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Second Half of the Course, extending from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *vivâ voce* examination is held during the First Half Course and the commencement of the Second Half Course.

II. *Organic Chemistry.*

This commences in the second week in February, and occupies Five lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Practical Chemistry.

Mondays, Tuesdays, Thursdays, and Fridays, from 12 to 1.

The Course consists of about Forty Lessons, the first twenty being given in the five weeks preceding the Christmas Vacation, the remainder immediately after it.

The First Half includes the portion of Chemistry required for the Matriculation Examination.

For particulars, see the Prospectus of the Summer Session.

Fee for the Course, £4 4s.; Half Course, £2 12s. 6d.

B. ANALYTICAL AND PRACTICAL CHEMISTRY.

I. BIRKBECK LABORATORY.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c., study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analyses, vapour-densities, &c.; instruction in gas analysis.

More advanced students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners, and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

II. SUMMER COURSES.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee for the Course, £4 4s., including cost of materials and apparatus.

II. *Senior Course.*

About Ten Lessons, of two hours each, on Mondays, from 10 to 12, commencing in the first week in May. The Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, &c.: organic bases and alkaloids, constituents of blood, milk, urine, &c.

Volumetric methods of quantitative analysis of acids, alkalies, urea, prussic acid, iron, &c., are practised.

Fee for the Course, £2 2s., including cost of materials and apparatus.

C. SUMMER MATRICULATION COURSE.

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Wednesday, April 5th, at 11 a.m.

The Class will meet on the first five week days, from 11 to 12; and some other Meetings will be announced when the Class has assembled.

Fee for the Class, £4 4s., including cost of materials and apparatus.

EVENING CLASSES.

The Session is divided into three Terms, each of ten complete weeks, exclusive of vacations—

I. The Michaelmas Term, beginning on Monday, the 10th of October, and ending on Thursday, December 15th.

II. The Lent Term, beginning on Monday the 9th of January, and ending on Thursday, March 16th.

III. The Summer Term, beginning on Monday, the 20th of March, and ending on Thursday, June 8th; the Easter Vacation extending from the 6th to the 17th of April, both days inclusive.

The object of these Classes is to extend the benefits of the College Tuition especially to gentlemen engaged elsewhere during the day, and to provide Instruction in subjects not taught in the ordinary College Classes.

The Beadles have orders to admit gentlemen to any of the Classes, with the permission of the Professor or Teacher, as occasional visitors.

The Library is open for the convenience of the Students between 6.30 and 8.30 on the evenings when the Classes meet, except when it is wanted for other purposes.

Elementary Chemistry—Theoretical and Practical.

Professor Williamson, F.R.S., and Mr. Jones. Monday, from 7.30 to 9.30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common Non-Metallic Elements and the common Metals, their Compounds and chief Properties, and the best methods of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £2 2s. per Term.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Professor of Chemistry.—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland, and will be opened on Monday the 3rd of October, 1870. The Royal College of Chemistry having become the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. It will be opened on the 3rd of October, 1870. The nature of this instruction will be adapted to the special requirements of the Students. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c., and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months; £12 for two months; and £7 for one month.

Evening Lectures.—This year these lectures will consist of two courses of eight lectures each. Subjects—Chemistry and Natural Philosophy.

KING'S COLLEGE.

Professor of Chemistry—W. A. Miller, M.D., V.P.R.S.

Professor of Practical Chemistry—C. L. Bloxam.

Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *vivâ voce* and by written papers, are held at intervals during the course at the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the class.

Third Year.—Students who have completed six Terms in this Department are admitted to a Course of "Practical Chemistry," consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the Science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniell Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter, £2 2s. The Classes meet twice a week.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, BLOOMSBURY SQUARE, W.C.

School of Pharmacy. The Session (1870-71) will commence on Monday, October 3rd, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.
,, 2.—Chemistry of Inorganic Bodies.
,, 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—For registered apprentices and associates of the Society, for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Monday, the 3rd of October, under the direction of Professor Attfield, Ph.D. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

LADIES' MEDICAL COLLEGE.

The Ladies' Medical College, established by the Female Medical Society in order to teach to educated women the theory and practice of Midwifery and the accessory branches of medicine.

President—Lord Shaftesbury.

Hon. Sec.—Dr. James Edmunds.

The Seventh Annual Session will commence on Oct. 3, 1870, and extend to April, 1871, with a vacation of two weeks at Christmas.

The Lectures will occupy the afternoons of the Mondays, Tuesdays, Wednesdays, and Fridays, from 3 o'clock till 5.

Elementary Materia Medica.—(Teachership now vacant).

Elementary Chemistry.—Mr. J. R. Newlands.

Fee for two sessions' attendance upon the Lectures on Midwifery, Anatomy, and Physiology, Medical Science, and Hygiene, £10 10s.

Fee for each of the Extra Courses, one session, £1 1s.; two sessions, £1 11s. 6d.

Further details as to the objects and operations of the Society, and prospectuses of the College, may be obtained by letter to the Lady Secretary, 164, Great Portland Street, W.; or from the Hon. Sec., 4, Fitzroy Square, W.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten experimental lectures: fee, 5s. per term. Subjects:—Junior Class, Chemistry—first year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Chemistry.—Mr. G. Chaloner. Tuesday, 8 to 9.

NEW KENNINGTON INSTITUTE.

Evening Lectures and Practical Classes in Chemistry, Pharmacy, and all subjects connected with the Pharmaceutical Examinations, under the direction of Dr. Muter.

POLYTECHNIC INSTITUTION.

Course of Thirty Lessons in Inorganic Chemistry, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. Matthiessen, F.R.S. Monday, Wednesday, and Friday, at 9.15 a.m. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen, F.R.S. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday and Friday. One session, £2 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4.

LONDON HOSPITAL.

Lecturers on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Tuesday, and Saturday, at 9 a.m.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at 11. One session. £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch, Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory and Botanic Garden open daily, except Saturdays.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Dr. John Muter, M.A.—Laboratory, 289, Kennington Road. Prepares for examinations of Pharmaceutical Society.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Mr. A. Vacher, 20, Great Marlborough Street, Regent Street.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

EASTER TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m.; so that Students can work there at such times as may be convenient to them: and the Professor will attend to give instruction at the times above specified.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. Anderson. Thursday and Friday, at 2 p.m.

BIRMINGHAM.—KING EDWARD VI. GRAMMAR SCHOOL.

Teacher of Chemistry.—G. Gore, F.R.S.

Assistant Teacher of Chemistry.—J. G. Grenfell, B.A.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—M. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Principal.—Rev. J. Constable, M.A.

Professors.

Agriculture.—J. Wrightson, F.C.S., M.R.Ag.Coll.
Chemistry.—A. H. Church, M.A.
Chemical Assistant.—E. Kinch.
Natural History.—W. R. McNab, M.D.
Veterinary Surgery.—J. McBride, M.R.C.V.S.
Surveying.—The Principal.
Drawing.—J. Miller.

Three courses of Lectures on Chemistry are being delivered during the present session, which commenced August 15th.

Agricultural Chemistry, on Thursdays at 10.

Organic Chemistry, on Tuesdays and Wednesdays, at 9.

Inorganic Chemistry, on Mondays at 9, and Tuesdays at 2.

There are also three classes for the study of practical chemistry. Students occupy themselves with Chemical Manipulation during the first session, Qualitative Analysis during the second, and Quantitative Analysis during the third. The Laboratory of the College is open from 9 a.m. to 5 p.m. In the Private Laboratory of the Professor of Chemistry researches and analysis, relating chiefly to Agricultural Chemistry, are carried on.

Text Books.—Church's "Laboratory Guide" (2nd edition) "How Crops Grow" (Church and Dyer's edition), Fownes's "Chemistry," Anderson's "Agricultural Chemistry."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

WINTER SESSION.

Chemical Lecturer.—Mr. J. C. Brown, B.Sc., F.C.S.

Monday, Tuesday, Thursday, and Friday, at 10.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. J. C. Brown, B.Sc., F.C.S.

Tuesday, Wednesday, and Thursday, at 10.30. One course, £3 3s.

The Laboratory is open daily, from 10 to 4.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY,

7, IRWELL CHAMBERS, FAZUCKERLY STREET, OLD HALL STREET, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Pupils may attend at any time between the hours of 9.30 a.m., and 5 p.m. (Saturdays, 9.30 a.m. and 1 p.m.), and may work every day, or any numbers of days, or portion of a day in the week, and for any period most convenient to themselves.

The Laboratory is also open two evenings per week for practical work.

Lectures one evening each week.

A separate working bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of one intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of Chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Dr. Sheridan Muspratt, F.R.S.E., M.R.I.A., F.C.S., &c.

Assistant.—Mr. Martin Murphy, F.C.S.

The Course of Instruction in this College is entirely devoted to Laboratory work. The term is three months, and dates from time of entrance. Fee for working six days per week, £12 12s.; five days, £11 11s.; four days, £10 10s.; three days, £9 9s.; two days, £8 8s.; and one day per week, £6 6s. Hours of attendance, from 10 a.m. till 5 p.m. The Students' laboratories close at 1 p.m. on Saturdays.

Medical students may enter for one hour per day per session. Fee, £3 3s.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

SESSION 1870-71.

Chemical Classes for Instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of Instruction in abstract and Applied Chemistry will commence on Thursday, September 22nd, at 8 p.m., on which evening the teacher of the classes will deliver an Introductory Lecture.

Fees, payable in advance:—Elementary Chemistry, Thursday, per session, £1 15s.; or 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, £1 1s. per session. Organic Chemistry, Friday, per session, 10s. 6d. Practical Chemistry, Tuesday, per session, £1 1s.; or 3s. 6d. per month, including apparatus and material. The session extends over seven months, from October to April inclusive.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCE.

Masters.—T. S. Aldis, M.A. (Cantab.) W. M. Watts, D.Sc. (Lond.); J. Angell, Esq., and S. Edwards, B.A.

There is a large Chemical Laboratory attached to the School, and Chemistry and the various branches of Physics are regularly taught. Arrangements can be made for students to devote their whole time to Physical Science and Mathematics.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNECTION WITH THE UNIVERSITY OF LONDON).

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties

and mode of preparation of the non-metallic elementary bodies and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, for each class, £3 3s. For both classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

Extra Class.—Wednesday, from four to five p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course.

Students attending this class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

Senior Assistant.—Mr. C. Schorlemmer, F.C.S.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this class. Fee, £1 11s. 6d.

Chemical Calculations.—In this class, instruction and special practice is given, by Mr. Schorlemmer, on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degress, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

Professor H. E. Roscoe, B.A., Ph.D., F.R.S.

Lecture Class (First Course—The Non-Metallic Elements).—Monday, from 8.35 to 9.35 p.m.

Lecture Class—(Second Course—The Metals). Friday, from 8.35 to 9.35 p.m.

Lecture Class (Third Course—Organic Chemistry).—Mr. C. Schorlemmer, F.C.S. Thursday from 8.35 to 9.35 p.m.

Laboratory Courses of Practical Chemistry.

Professor Roscoe, F.R.S., and Mr. Schorlemmer, F.C.S.

Junior and Senior Divisions.—Monday, from 6 to 8.30 p.m.

Pharmaceutical Course.—Monday and Wednesday.

COLLEGE OF MEDICINE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

Education in Pharmacy.—The Council of the College have added a Lectureship on Pharmacy to those at present existing. The proposed curriculum for Students in Pharmacy will consist of attendance on Lectures on Botany, Materia Medica, Chemistry, and Pharmacy. The Lectures on the two former of these subjects will be delivered in the summer, and those on the two latter in the winter session of study.

Lecturer on Chemistry.—Mr. A Freire-Marreco.

Monday, Wednesday, Thursday, and Friday, at 4 p.m.

EVENING COURSES.

Chemical Physics.—Every Monday, at 7.30 p.m.

Inorganic Chemistry.—Every Wednesday, at 7.30 p.m.

Practical Pharmacy.—B. S. Proctor. Every Tuesday, at 7.30 p.m.

This course will include—General Processes and Physics applied to Pharmacy—Pharmacopœial Processes, and the most important recent improvements in Pharmaceutical preparations—Dispensing operations—Testing and the Test Solutions of the Pharmacopœia. The course will be illustrated, whenever practicable, with apparatus, experiments, and processes in operation.

Practice of Chemistry.—The Laboratories are open daily throughout the year from 10 to 5 o'clock. Non-Medical students can attend Laboratory practice and receive Instruction in Analysis.

Students attending the Laboratory practice and Lectures on Chemistry, who have passed the Durham Registration Examination, or any Examination in Arts recognised as its equivalent, will be registered on the books of the College as Students in Chemistry.

Fees.—Perpetual ticket for Pharmacy Curriculum, £6 6s. (this applies only to Students at present engaged in Pharmacy, and who enter before October, 1871). Separate Courses of Lectures (each), £4 4s. Laboratory Practice, 6 days per week, £31 10s. per annum; 4 days per week, £21 per annum. Special arrangements for shorter attendances. These fees admit to all the Courses in Chemistry.

SHEFFIELD.

Mr. W. Baker, F.C.S. Laboratory for Theoretical and Practical Chemistry, 46, High Street, Sheffield.

SCHOOL OF CHEMISTRY,

1, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session, Mr. A. H. Allen, F.C.S., will deliver a Course of Forty-five Lectures on Chemistry.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry commence on Wednesday, November 2nd, and continue to be delivered daily during the five months of the Winter Session. The Lectures form a complete Course; the New Nomenclature and Notation are employed throughout, and special Lectures in Technological Chemistry are given. Tutorial Class Examinations are held during the Session, and Excursions are arranged for visiting the principal Chemical Manufactories.

The Instructions in Analytical Chemistry are conducted in the laboratories at Surgeons' Hall, which are now open daily, under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboraties at Surgeons' Hall. The subjects selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lecture, £3 5s. (University Graduation, £4 4s.) Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Dr. R. Carter Moffat.

Assistants.—Mr. Marshall and Mr. D. Swan.

1. Course of Lectures on Chemistry for Medical Students, Manufacturers, Agriculturists, and others. Daily at 12; beginning October 26, and terminating in April.

The design of this Course, which comprises more than one hundred Lectures, is to instruct the Student in the Departments of Scientific Chemistry, and the application of its priniciples to Manufactures, Medicine, &c. Certificates of attendance on these Lectures are received by the Royal College of Physicians of London and Edinburgh, by the Royal Colleges of Surgeons of England, Ireland, and Edinburgh, by the Faculty of Physicians and Surgeons of Glasgow, by the Army, Navy, and East India Boards, and by the Apothecaries' Halls; they also qualify for graduation in the University of London, &c.

2. Instruction in the various Departments of Practical and Analytical Chemistry in the Laboratories, from 10 till 4.

3. Evening Course of Popular Lectures on General Chemistry, on Tuesdays at 8.30. Practical class in connection at 7.

4. Evening Classes for Technical Chemistry, on Mo days, Wednesdays, and Fridays.

5. Practical Classes for Medical Students, daily in the Laboratory, at 10.

6. Summer Course of Practical Chemistry for Medical Students, commencing May 2, 1871, at 11.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry.—Dr. R. Carter Moffat.

IRELAND.

DUBLIN.—TRINITY COLLEGE,

Professor of Chemistry.—Dr. Apjohn, F.C.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND, STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The Subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry, and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology, and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant Chemist.—W. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the Direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships, of the value of £50 each, yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 3rd.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 29, 1870.

This number contains nothing but a memoir strictly relating to geometry. The meeting of the Academy only lasted for a quarter of an hour.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 12, 1870.

This number contains the following original essays and papers:—

Observations on some of the Compounds of Cerium.—F. L. Sonnenschein.—After a brief review of the labours of others on this subject, the chief point of interest in this paper is the author's communication of the fact that oxide of cerium is an excellent reagent and test for strychnia. When the last-named substance is well moistened with concentrated sulphuric acid, and there is added to it a mixture of proto-sesquioxide of cerium, a very fine blue colouration ensues, which gradually verges to cherry-red, and then remains unchanged, even for several days. The author states that, by this test, even so small a quantity of strychnia as 0·000001 grm. can be detected. Other alkaloids yield, with the same test, quite different reactions, as, for instance—brucine, orange, becoming at last yellow; morphine, olive-brown, finally brown; narcotine, first brownish, cherry-red, remaining at last cherry-red; quinine, pale yellow; cinchonine remains colourless.

On Anthrachinon.—G. Græbe and C. Liebermann.—This memoir treats chiefly on the action of caustic potassa at a high temperature upon anthrachinon, and on the yellow substance, red-coloured in alkaline solution, which is the result of that reaction. The authors state that the yellow colour of the body alluded to is due to the presence of anthrachinhydron, while the anthrahydrochinon is itself a colourless substance.

Alizarine and Purpurine.—G. Græbe and C. Liebermann.—They have found that the anthrachinon-bisulpho acid can be obtained directly from anthracen, by the action of a mixture of fuming and ordinary concentrated sulphuric acid upon the bibromide or bichloride of anthracen. This reaction takes place according to the following formulæ:—

$$C_{14}H_8Br_2 + 4SO_4H_2 = C_{14}H_6(O_2)(SO_3H)_2 + 2SO_2 + 4H_2O + 2Br;$$

$$-C_{14}H_8Cl_2 + 3SO_4H_2 = C_{14}H_6(O_2)(SO_3H)_2 + 2HCl + SO_2 + 2H_2O.$$

The sulpho acids so obtained yield, when fused with caustic potassa, alizarine. The authors describe, further, a series of experiments made with the view to convert alizarine into purpurine, but they did not obtain the last-named substance.

Wax Contained in Opium.—O. Hesse.—The author describes, at great length, the process by which, from the so-called *fæces opii*, may be obtained a waxy matter which, on closer investigation, proved to consist of two different substances—viz., cerotate of ceryl and palmitate of ceryl—the latter forming the chief portion of the mass. The first-named substance fuses at 82·5°; the last-named substance, $C_{42}H_{86}O_2$, fuses at 79°, is soluble in alcohol, chloroform, ether, and aceton, and crystallises in prismatic-shaped crystals.

Contribution to our Knowledge on Diamylen.—W. von Schneider.—This paper is chiefly a series of very lengthy and complicated formulæ.

Bromogallic Acid.—E. Priwoznik.—This paper is divided into the following sections:—Bromogallic acid and acetyl-chloride; tetracetyl-gallic acid and bromine; gallic acid and bromated bromide of acetyl; bibromogallic acid and oxide of silver; bibromogallic acid and aniline; bibromogallic acid and cyanides.

New Method of Formation of Chinons.—P. Weselsky.

Contribution to our Knowledge on Stanno-Triethyl.—A. Ladenburg.

Nitro-Derivatives of the Phenyl-Acetic Acid.—B. Radziszewski.—The author describes orthonitro-phenyl-acetic acid, a solid substance, soluble in water, fusing at 98°, and crystalline; its salts crystallise with difficulty.

Carbanilidic Acid Ether.—H. Schiff.—This memoir is divided into the following sections:—Triphenyl-cyanurate (*cyanurat*); triphenyl-isocyanurate—

$$C_3O_3\begin{cases} N.C_6H_5 \\ N.C_6H_5 \\ N.C_6H_5 \end{cases}$$

diphenyl-carbamide; triphenyl-biuret.

Aromatic Cyanates.—A. W. Hofmann.—This lengthy memoir is divided into the following sections:—Phenyl-urethan; phenyl-cyanate; tolyl-urethan; tolyl-cyanate; xylyl-urethan; xylyl-cyanate; naphthyl-urethan; naphthyl-cyanate.

The following are lecture experiments, communicated by Dr. A. W. Hofmann:—

Ignition of Hydrogen Compounds in Contact with Fuming Nitric Acid.—When a few drops of rather warm fuming nitric acid are poured into a glass cylinder containing the non-spontaneous combustible phosphuretted hydrogen gas, a very violent, and even somewhat dangerous detonation ensues. Pure sulphuretted hydrogen, best obtained free from excess of hydrogen, by evolving it from native black sulphuret of antimony and hydrochloric acid gas, becomes immediately ignited when brought into contact with some strong fuming nitric acid. When a few c.c. of moderately-warmed and strong nitric acid are poured into a moderately large-sized cylinder, containing hydriodic acid gas, a red flame bursts forth, violet-coloured fumes are given off, and the interior of the cylinder becomes covered with steel-grey crystals of iodine.

Colouring Power of Some of the Aniline Dyes.—After referring to the great many experimental illustrations of the divisibility of matter, the author quotes the following:—The solution of any salt of rosaniline (for this purpose, since only very dilute solutions are used, it is quite indifferent what salt be used), mixed with a few drops of acetic acid, and so diluted with water as to have 1 part of the rosaniline salt to 1,000,000 of water (1 milligrm. to 1 litre of liquid) is yet deeply carmine-coloured, and yields a fluid capable of dyeing silk thread, previously moistened with dilute acetic acid. When the coloured liquid is diluted with water, so that 25,000,000 parts of that liquid are present (1-25th of a milligrm. of the salt to the litre), the liquid is yet distinctly coloured; and silk, immersed in this bath for a quarter of an hour, is dyed pale red-coloured when removed from the liquid. Even 1 part of the rosaniline salt in 100,000,000 parts of water is visible, if the layer of liquid seen through is about ½ a metre thick.

Formation of Nitric Acid during the Combustion of Hydrogen in Air.—The author describes an experiment, intended to prove, on a large scale, the formation of water during the combustion of hydrogen, so that 30 grms. of water were formed in as many minutes. The water thus formed reddened tincture of litmus, had a decidedly acid taste, and yielded all the characteristic tests of nitric acid.

Fluid Cyanogen.—A full translation appeared in our last number.

Alternate Reduction and Oxidation.—A well-polished small copper bell is placed in a ring on a triangle, and made red-hot by causing a strong gas flame to play upon it, so as to render the metal red-hot, and, consequently, very soon black. As soon as this is the case, a strong current of hydrogen gas is directed upon the metal, by means of a flexible tube fastened to the neck of a glass funnel large enough to cover the bell. As soon as the hydrogen gas comes into contact with the red-hot metal, the layer of black oxide of copper is removed, and the metal appears as before it was heated. By removing the current of hydrogen, the oxygen of the air again acts upon the hot metal; and thus this alternate oxidation and reduction may be continued, provided the metal had been made thoroughly red-hot to begin with. The hydrogen should be pure, and free from traces, even, of sulphur or arsenic, in order that the experiment be successful.

Size of the Gas Molecules of Inorganic Compounds.—R. Rieth.

Some of the Derivatives of Muconic Acid.—H. Limpricht.—This paper contains brief notices of the following bodies.—Bromomuconic acid; tribrom-adipinic acid; tetrabrom-adipinic acid; oxymuconic acid; adipino-tartaric acid; trioxy-adipic acid.

Preliminary Notice on Alizarine.—V. Wartha.—The author states that, being engaged with researches on Turkey-red dyeing, he has found that the peculiarly-brilliant red colour known by this term is due to a peculiar combination of alizarine with a fatty acid, which compound is soluble in a mixture of ligroine and ether, and does not even adhere very strongly to the cloth, since it may be readily removed therefrom by the liquid mixture alluded to. On evaporating this solution, there is left a brilliantly scarlet-coloured fatty substance, which, only after having been fused with caustic potassa, exhibits the characteristic reactions of alizarine. The author also states that the preparation of alizarine from madder is readily performed by first exhausting the substance (madder) with ligroine, and next treating it with a mixture of alcohol and hydrochloric acid (alcohol saturated with the gas). On diluting this solution with much water, the alizarine is precipitated, in almost a chemically pure state, in the shape of an orange-coloured flocculent body. A carefully-conducted comparative investigation has proved to the author that the vegetable alizarine sublimes at between 130° and 140°. The synthetically-prepared artificial alizarine requires a temperature of from 280° to 300°. By ligroine, the author means light petroleum oil, such as is used in vapour or sponge lamps.

Preparation of Naphthylamine.—M. Ballo.

Dyes and Pigments to be Derived or Obtained from the Salts of Rosaniline, Brom-Naphthaline, and Naphthylamine.—M. Ballo.—These memoirs are too lengthy to admit of any useful abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, August 20 and 27, and September 3, 1870.

This number does not contain any original papers relating to chemistry and collateral sciences, but the lectures on the—

Flying of Birds—M. Marey—Are published in full, illustrated by several diagrams and woodcuts.

Royal School of Mines.—Director, Sir Roderick Impey Murchison, Bart., K.C.B., F.R.S., &c.

During the Twentieth Session, 1870-1871, which will commence on the 10th of October, the following COURSES of LECTURES and PRACTICAL DEMONSTRATIONS will be given:—

1. Chemistry—By E. Frankland, Ph.D., F.R.S.
2. Metallurgy—By John Percy, M.D., F.R.S.
3. Natural History—By T. H. Huxley, LL.D., F.R.S.
4. Mineralogy } —By Warington W. Smyth, M.A., F.R.S.
5. Mining }
6. Geology—By A. C. Ramsay, LL.D., F.R.S.
7. Applied Mechanics—By T. M. Goodeve, M.A.
8. Physics—By Frederick Guthrie, B.A., Ph.D.

Instruction in Mechanical Drawing, by the Rev. J. Haythorne Edgar, M.A.

The Fee for Students desirous of becoming Associates is £30 in one sum, on entrance, or two annual payments of £20, exclusive of the Laboratories.

Pupils are received in the Royal College of Chemistry (the Laboratory of the School), under the direction of Dr. Frankland, and in the Metallurgical Laboratory, under the direction of Dr. Percy.

Tickets to separate Courses of Lectures are issued at £3 and £4 each.

Officers in the Queen's Service, Her Majesty's Consuls, Acting Mining Agents and Managers may obtain tickets at reduced prices.

Certificated Schoolmasters, Pupil-Teachers, and others engaged in education, are also admitted to the Lectures at reduced fees.

His Royal Highness the Prince of Wales grants two Scholarships, and several others have also been established by Government.

For a Prospectus, and information, apply to the Registrar, Royal School of Mines, Jermyn Street, London, S.W.

TRENHAM REEKS, Registrar.

Pharmaceutical Society of Great Britain, 17, Bloomsbury Square, W.C.—School of Pharmacy—Session 1870-71. The Session will commence on Monday, October 3rd, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY PROFESSOR REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

Part 1.—Physics in Relation to Chemistry and Pharmacy.
" 2.—Chemistry of Inorganic Bodies.
" 3.—Chemistry of Organic Bodies.

ON BOTANY AND MATERIA MEDICA, BY PROFESSOR BENTLEY.

Part 1.—Structural and Physiological Botany.
" 2.—Organic Materia Medica.
" 3.—Systematic Botany and Practical Demonstrations of Plants.

The first and second parts of this Course, extending over the Winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 o'clock. The third part of the Course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park.

FEES.—For Registered Apprentices and Associates of the Society, for either of the above Courses, One Guinea; for either part separately, Half a Guinea. For those not connected with the Society, Two Guineas for either of the above Courses; One Guinea for either part separately.

Students have free admission to the Library and Museum.

LABORATORY.—The Suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Monday, October 3rd, under the direction of Professor Attfield. Fee for the entire Session of ten months, Twenty-five Guineas. The Laboratories are open from half-past 9 a.m. till 5 p.m. Students can enter at any period during the Session.

PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

South London School of Chemistry and Pharmacy, New Kennington Institute, 289, Kennington Road, S.E.
Director, and Teacher of Chemistry, Dr. J. Muter, M.A.

Botany and Materia Medica—Dr. Renadin.
Practical Chemistry—Mr. Earp.

Evening Classes for gentlemen engaged in business in Latin, Mathematics, Chemistry, Botany, Materia Medica, Physics, and Natural History. Special preparation for the Examinations at the London University and Pharmaceutical Society.

For terms and particulars, apply to Dr. Muter, or to Mr. W. Baxter, Secretary.

*** A Vacancy in the Laboratory for a Pupil-Assistant.

North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1870—1871 will commence on the 3rd of October, when the Laboratories will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes, Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c.

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, KENTISH TOWN ROAD, N.W.

Royal Veterinary College, Great College Street, Camden Town, London.

The Lectures will commence at the above Institution on Tuesday, October 4th.

The Introductory Address will be delivered by Professor Tuson, at 12 o'clock.

Anatomy, Physiology, and Pathology of the Horse—ProfesorSpooner.
Anatomy, Physiology, and Pathology of other Domesticated Animals—Professor Simonds.
Descriptive Anatomy, with Physiology—Deputy Professor Pritchard.
Chemistry, Materia Medica, and Toxicology—Professor Tuson.
Anatomical Demonstrations—Assistant Professor Axe.
Infirmary Practice and Clinical Instruction daily—Professors Spooner, Simonds, and Pritchard.

Perpetual fee to all the Lectures, with Infirmary Practice and Anatomical Demonstrations daily, 25 guineas.

It is desirable that intending Pupils should present themselves at the Royal Veterinary College, for matriculation at 10 o'clock a.m. precisely, on Thursday, the 29th of September next.

A Prospectus will be forwarded on application.

CHARLES SPOONER, Principal.

August 25, 1870.

King's College.—Medical Department.—The WINTER SESSION will open on Monday, October 3, with an Introductory Lecture by Professor Wood, at 3 p.m.

Warneford Scholarships.—Students entering the Medical Department of this College in October, 1870, will have the exclusive privilege of contending for two Scholarships of £25 each, for three years. These Scholarships are given for proficiency in Divinity, Classics, Mathematics, History, and English.

Five Medical Scholarships are awarded at the close of each Winter Session for proficiency in professional subjects, viz., one of £40 for two years, one of £30 for one year, and three of £20 for one year.

Endowed Prizes of the value of £25, £15, £10, and £4 4s. each, and College Prizes of the value of £50, are annually awarded.

For further information apply personally, or by letter marked outside "Prospectus," to J. W. Cunningham, Esq., Secretary.

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SESSION 1870-71.

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FREDERICK J. SIDNEY, LL.D., Secretary.

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The School is in connection with the Department of Science and Art; and Examinations are held at the School in May. Two hundred and fifty-six pupils passed the last Examination.

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FACULTY OF MEDICINE—SESSION 1870-71.

WINTER SESSION, commencing on Wednesday, October 26th.

Anatomy—Professor Struthers, M.D. 11 a.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 9 a.m. £2 2s.
Chemistry—Professor Brazier. 3 p.m. £3 3s.
Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.
Surgery—Professor Pirrie, C.M., F.R.S.E. 10 a.m. £3 3s.
Practice of Medicine—Professor Macrobin, M.D. 3 p.m. £3 3s.
Midwifery and Diseases of Women and Children—Professor Inglis, M.D. 2 p.m. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol, F.G.S. 2 p.m. £3 3s.
Medical Logic and Medical Jurisprudence—Professor Ogston, M.D. 9 a.m. £3 3s.

SUMMER SESSION, commencing on the First Monday of May.

Botany—Professor Dickie, M.D. 9 a.m. £3 3s.
Materia Medica (100 Lectures)—Professor Harvey, M.D. 3 and 4 p.m. £3 3s.
Practical Anatomy, and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 2 p.m. £2 2s.
Practical Chemistry—Professor Brazier. 10 a.m. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.

The Anatomical Course in Summer includes Instruction in General Anatomy and in the Use of the Microscope; and Instruction in Osteology for Beginners.

Matriculation Fee (including all dues) for the Winter and Summer Sessions, £1. For the Summer Session alone, 10s.

Royal Infirmary: Daily at Noon. Physicians—Drs. Harvey, Smith, and Beveridge. Surgeons—Drs. Pirrie, Kerr, and Fiddes. Junior Surgeon—Dr. A. Ogston. Ophthalmic Surgeon—(Vacant). Dental Surgeon—Mr. Williamson. Pathologist—Dr. Rodger. Perpetual Fee to Hospital Practice, £6—or, first year, £3 10s.; second year, £3.

Clinical Medicine—Drs. Harvey and Smith. £3 3s.
Clinical Surgery—Drs. Pirrie, Kerr, and Fiddes. £3 3s.
Pathological Anatomy—Dr. Rodger. £2 2s.

A three month's course of Practical Ophthalmology is given in Summer by Dr. A. Ogston, commencing early in May.

General Dispensary and Lying-in and Vaccine Institution: Daily.

Eye Institution—Daily.

Practical Midwifery—Under the Superintendence of Dr. Inglis.

Royal Lunatic Asylum: Physician—Dr. Jameson. Clinical Instruction is given for three months in the year.

The Regulations relative to the Registration of Students of Medicine, and the Granting of Degrees in Medicine and Surgery, may be had of Dr. Macrobin, Dean of the Faculty of Medicine.

Full information regarding the Classes and Degrees in the Faculties of Arts, Law, and Divinity, and in regard to Bursaries and Scholarships, will be found in the UNIVERSITY CALENDAR, published by Messrs. Wyllie and Son, Union Street, Aberdeen—by post, 2s. 2d.

Lectures on Mineralogy applied to Geology and the Arts are given by Professor TENNANT, F.G.S., at King's College, London, on Wednesday and Friday Mornings, from 9 to 10 o'clock, and on Thursday Evenings from 8 to 9, from October 7th, to Christmas, to which the public are admitted on paying the College Fees, namely, Two Guineas to the Morning Course, and One Guinea to the Evening.

The Students are accompanied by the Professor to the Museum of Practical Geology, the British Museum, and other Public institutions, and also on excursions into the country.

MR. TENNANT also gives private instruction in Mineralogy and Geology at his residence, 149, Strand, London, W.C.

THE CHEMICAL NEWS.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Liverpool Meeting, September 14, 1870.

INAUGURAL ADDRESS OF THE PRESIDENT,

Thomas H. Huxley, LL.D., F.R.S., &c.,
Professor of Natural History in the Royal School of Mines.

My Lords, Ladies, and Gentlemen,—

It has long been the custom for the newly-installed President of the British Association for the Advancement of Science to take advantage of the elevation of the position in which the suffrages of his colleagues had, for the time, placed him, and, casting his eyes around the horizon of the scientific world, to report to them what could be seen from his watch-tower; in what directions the multitudinous divisions of the noble army of the improvers of natural knowledge were marching; what important strongholds of the great enemy of us all, Ignorance, had been recently captured; and, also, with due impartiality, to mark where the advanced posts of science had been driven in, or a long-continued siege had made no progress.

I propose to endeavour to follow this ancient precedent, in a manner suited to the limitations of my knowledge and of my capacity. I shall not presume to attempt a panoramic survey of the world of Science, nor even to give a sketch of what is doing in the one great province of Biology, with some portions of which my ordinary occupations render me familiar. But I shall endeavour to put before you the history of the rise and progress of a single biological doctrine; and I shall try to give some notion of the fruits, both intellectual and practical, which we owe, directly or indirectly, to the working out, by seven generations of patient and laborious investigators, of the thought which arose, more than two centuries ago, in the mind of a sagacious and observant Italian naturalist.

It is a matter of every day experience that it is difficult to prevent many articles of food from becoming covered with mould; that fruit, sound enough to all appearance, often contains grubs at the core; that meat, left to itself in the air, is apt to putrefy and swarm with maggots. Even ordinary water, if allowed to stand in an open vessel, sooner or later becomes turbid and full of living matter.

The philosophers of antiquity, interrogated as to the cause of this phenomena, were provided with a ready and a plausible answer. It did not enter their minds even to doubt that these low forms of life were generated in the matters in which they made their appearance. Lucretius, who had drunk deeper of the scientific spirit than any poet of ancient or modern times except Goethe, intends to speak as a philosopher, rather than as a poet, when he writes that "with good reason the earth has gotten the name of mother, since all things are produced out of the earth. And many living creatures, even now, spring out of the earth, taking form by the rains and the heat of the sun." The axiom of ancient science, "that the corruption of one thing is the birth of another," had its popular embodiment in the notion that a seed dies before the young plant springs from it; a belief so widespread and so fixed, that Saint Paul appeals to it in one of the most splendid outbursts of his fervid eloquence—

"Thou fool, that which thou sowest is not quickened, except it die."

The proposition that life may, and does, proceed from that which has no life, then, was held alike by the philosophers, the poets, and the people, of the most enlightened nations, eighteen hundred years ago; and it remained the accepted doctrine of learned and unlearned Europe, through the Middle Ages, down even to the seventeenth century.

It is commonly counted among the many merits of our great countryman, Harvey, that he was the first to declare the opposition of fact to venerable authority in this, as in other matters; but I can discover no justification for this widespread notion. After careful search through the "Exercitationes de Generatione," the most that appears clear to me is, that Harvey believed all animals and plants to spring from what he terms a "*primordium vegetale*," a phrase which may nowadays be rendered "a vegetative germ;" and this, he says, is "*oviforme*," or "egg-like;" not, he is careful to add, that it necessarily has the shape of an egg, but because it has the constitution and nature of one. That this "*primordium oviforme*" must needs, in all cases, proceed from a living parent is nowhere expressly maintained by Harvey, though such an opinion may be thought to be implied in one or two passages; while, on the other hand, he does, more than once, use language which is consistent only with a full belief in spontaneous or equivocal generation. In fact, the main concern of Harvey's wonderful little treatise is not with generation, in the physiological sense, at all, but with development; and his great object is the establishment of the doctrine of epigenesis.

The first distinct enunciation of the hypothesis that all living matter has sprung from pre-existing living matter, came from a contemporary, though a junior, of Harvey, a native of that country, fertile in men great in all departments of human activity, which was to intellectual Europe, in the sixteenth and seventeenth centuries, what Germany is in the nineteenth. It was in Italy, and from Italian teachers, that Harvey received the most important part of his scientific education. And it was a student trained in the same schools, Francesco Redi—a man of the widest knowledge and most versatile abilities, distinguished alike as scholar, poet, physician, and naturalist—who, just two hundred and two years ago, published his "Esperienze intorno alla Generazione degl' Insetti," and gave to the world the idea, the growth of which it is my purpose to trace. Redi's book went through five editions in twenty years; and the extreme simplicity of his experiments, and the clearness of his arguments, gained for his views, and for their consequences, almost universal acceptance.

Redi did not trouble himself much with speculative considerations, but attacked particular cases of what was supposed to be "spontaneous generation" experimentally. Here are dead animals, or pieces of meat, says he; I expose them to the air in hot weather, and in a few days they swarm with maggots. You tell me that these are generated in the dead flesh; but, if I put similar bodies, while quite fresh, into a jar, and tie some fine gauze over the top of the jar, not a maggot makes its appearance, while the dead substances, nevertheless, putrefy just in the same way as before. It is obvious, therefore, that the maggots are not generated by the corruption of the meat; and that the cause of their formation must be a something which is kept away by gauze. But gauze will not keep away aëriform bodies, or fluids. This something must, therefore, exist in the form of solid particles too big to get through the gauze. Nor is one long left in doubt what these solid particles are; for the blowflies, attracted by the odour of the meat, swarm round the vessel, and, urged by a powerful, but, in this case, misleading instinct, lay eggs, out of which maggots are immediately hatched, upon the gauze. The conclusion, therefore, is unavoidable; the maggots are not generated by the meat, but the eggs

which give rise to them are brought through the air by the flies.

These experiments seem almost childishly simple, and one wonders how it was that no one ever thought of them before. Simple as they are, however, they are worthy of the most careful study, for every piece of experimental work since done, in regard to this subject, has been shaped upon the model furnished by the Italian philosopher. As the results of his experiments were the same, however varied the nature of the materials he used, it is not wonderful that there arose in Redi's mind a presumption that, in all such cases of the seeming production of life from dead matter, the real explanation was the introduction of living germs from without into that dead matter. And thus the hypothesis that living matter always arises by the agency of pre-existing living matter, took definite shape; and had, henceforward, a right to be considered and a claim to be refuted, in each particular case, before the production of living matter in any other way could be admitted by careful reasoners. It will be necessary for me to refer to this hypothesis so frequently, that, to save circumlocution, I shall call it the hypothesis of *Biogenesis*; and I shall term the contrary doctrine—that living matter may be produced by not living matter—the hypothesis of *Abiogenesis*.

In the seventeenth century, as I have said, the latter was the dominant view, sanctioned alike by antiquity and by authority; and it is interesting to observe that Redi did not escape the customary tax upon a discoverer of having to defend himself against the charge of impugning the authority of the Sciptures; for his adversaries declared that the generation of bees from the carcass of a dead lion is affirmed, in the book of Judges, to have been the origin of the famous riddle with which Samson perplexed the Philistines—

> "Out of the eater came forth meat,
> And out of the strong came forth sweetness."

Against all odds, however, Redi, strong with the strength of demonstrable fact, did splendid battle for Biogenesis; but it is remarkable that he held the doctrine in a sense which, if he had lived in these times, would have infallibly caused him to be classed among the defenders of "spontaneous generation." "Omne vivum ex vivo," "no life without antecedent life," aphoristically sums up Redi's doctrine; but he went no further. It is most remarkable evidence of the philosophic caution and impartiality of his mind, that, although he had speculatively anticipated the manner in which grubs really are deposited in fruits and in the galls of plants, he deliberately admits that the evidence is insufficient to bear him out; and he therefore prefers the supposition that they are generated by a modification of the living substance of the plants themselves. Indeed, he regards these vegetable growths as organs, by means of which the plant gives rise to an animal, and looks upon this production of specific animals as the final cause of the galls, and of, at any rate some, fruits. And he proposes to explain the occurrence of parasites within the animal body in the same way.

It is of great importance to apprehend Redi's position rightly; for the lines of thought he laid down for us are those upon which naturalists have been working ever since. Clearly, he held *Biogenesis* as against *Abiogenesis*; and I shall immediately proceed, in the first place, to enquire how far subsequent investigation has borne him out in so doing.

But Redi also thought that there were two modes of Biogenesis. By the one method, which is that of common and ordinary occurence, the living parent gives rise to offspring which passes through the same cycle of changes as itself—like gives rise to like; and this has been termed *Homogenesis*. By the other mode, the living parent was supposed to give rise to offspring which passed through a totally different series of states from those exhibited by the parent, and did not return into the cycle of the parent; this is what ought to be called *Heterogenesis*, the offspring being altogether, and permanently, unlike the parent. The term Heterogenesis, however, has unfortunately been used in a different sense, and M. Milne-Edwards has, therefore, substituted for it *Xenogenesis*, which means the generation of something foreign. After discussing Redi's hypothesis of universal Biogenesis, then, I shall go on to ask how far the growth of science justifies his other hypothesis of Xenogenesis.

The progress of the hypothesis of Biogenesis was triumphant and unchecked for nearly a century. The application of the microscope to anatomy in the hands of Grew, Leeuwenhoek, Swammerdam, Lyonet, Vallisnieri, Reaumur, and other illustrious investigators of nature of that day, displayed such a complexity of organisation in the lowest and minutest forms, and everywhere revealed such a prodigality of provision for their multiplication by germs of one sort or another, that the hypothesis of Abiogenesis began to appear not only untrue, but absurd; and, in the middle of the eighteenth century, when Needham and Buffon took up the question, it was almost universally discredited.

But the skill of the microscope-makers of the eighteenth century soon reached its limit. A microscope magnifying 400 diameters was a *chef-d'œuvre* of the opticians of that day; and, at the same time, by no means trustworthy. But a magnifying power of 400 diameters, even when definition reaches the exquisite perfection of our modern achromatic lenses, hardly suffices for the mere discernment of the smallest forms of life. A speck, only 1-25th of an inch in diameter, has, at 10 inches from the eye, the same apparent size as an object 1-10,000th of an inch in diameter, when magnified 400 times; but forms of living matter abound the diameter of which is not more than 1-40,000th of an inch. A filtered infusion of hay, allowed to stand for two days, will swarm with living things, among which, any which reaches the diameter of a human red blood-corpuscle, or about 1-3200th of an inch, is a giant. It is only by bearing these facts in mind, that we can deal fairly with the remarkable statements and speculations put forward by Buffon and Needham in the middle of the eighteenth century.

When a portion of any animal or vegetable body is infused in water, it gradually softens and disintegrates; and, as it does so, the water is found to swarm with minute active creatures, the so-called Infusorial Animalcules, none of which can be seen, except by the aid of the microscope; while a large proportion belong to the category of smallest things of which I have spoken, and which must have all looked like mere dots and lines under the ordinary microscopes of the eighteenth century.

Led by various theoretical considerations which I cannot now discuss, but which looked promising enough in the lights of that day, Buffon and Needham doubted the applicability of Redi's hypothesis to the infusorial animalcules, and Needham very properly endeavoured to put the question to an experimental test. He said to himself, if these infusorial animalcules come from germs, their germs must exist either in the substance infused, or in the water with which the infusion is made, or in the superjacent air. Now the vitality of all germs is destroyed by heat. Therefore, if I boil the infusion, cork it up carefully, cementing the cork over with mastic, and then heat the whole vessel by heaping hot ashes over it, I must needs kill whatever germs are present. Consequently, if Redi's hypothesis hold good, when the infusion is taken away, and allowed to cool, no animalcules ought to be developed in it; whereas, if the animalcules are not dependent on pre-existing germs, but are generated from the infused substance, they ought, by and by, to make their appearance. Needham found that, under the circumstances in which he made his experiments, animalcules always did arise in the infusions, when a sufficient time had elapsed to allow for their development.

In much of his work Needham was associated with Buffon, and the results of their experiments fitted in admirably with the great French naturalist's hypothesis of "organic molecules," according to which, life is the inde-

feasible property of certain indestructible molecules of matter, which exist in all living things, and have inherent activities by which they are distinguished from not living matter. Each individual living organism is formed by their temporary combination. They stand to it in the relation of the particles of water to a cascade, or a whirlpool; or to a mould, into which the water is poured. The form of the organism is thus determined by the reaction between external conditions and the inherent activities of the organic molecules of which it is composed; and, as the stoppage of a whirlpool destroys nothing but a form, and leaves the molecules of the water, with all their inherent activities intact, so, what we call the death and putrefaction of an animal, or of a plant, is merely the breaking up of the form, or manner of association, of its constituent organic molecules, which are then set free as infusorial animalcules.

It will be perceived that this doctrine is by no means identical with *Abiogenesis*, with which it is often confounded. On this hypothesis, a piece of beef, or a handful of hay, is dead only in a limited sense. The beef is dead ox, and the hay is dead grass; but the "organic molecules" of the beef or the hay are not dead, but are ready to manifest their vitality as soon as the bovine or herbaceous shrouds in which they are imprisoned are rent by the macerating action of water. The hypothesis, therefore, must be classified under Xenogenesis, rather than under Abiogenesis. Such as it was, I think it will appear, to those who will be just enough to remember that it was propounded before the birth of modern chemistry and of the modern optical arts, to be a most ingenious and suggestive speculation.

But the great tragedy of Science—the slaying of a beautiful hypothesis by an ugly fact—which is so constantly being enacted under the eyes of philosophers, was played, almost immediately, for the benefit of Buffon and Needham.

Once more, an Italian, the Abbé Spallanzani, a worthy successor and representative of Redi in his acuteness, his ingenuity, and his learning, subjected the experiments and the conclusions of Needham to a searching criticism. It might be true that Needham's experiments yielded results such as he had described, but did they bear out his arguments? Was it not possible, in the first place, that he had not completely excluded the air by his corks and mastic? And was it not possible, in the second place, that he had not sufficiently heated his infusions and the superjacent air? Spallanzani joined issue with the English naturalist on both these pleas; and he showed that if, in the first place, the glass vessels in which the infusions were contained were hermetically sealed, by fusing their necks; and if, in the second place, they were exposed to the temperature of boiling-water for three-quarters of an hour, no animalcules ever made their appearance within them. It must be admitted that the experiments and arguments of Spallanzani furnish a complete and a crushing reply to those of Needham. But we all too often forget that it is one thing to refute a proposition and another to prove the truth of a doctrine which implicitly, or explicitly, contradicts that proposition; and the advance of science soon showed that, though Needham might be quite wrong, it did not follow that Spallanzani was quite right.

Modern Chemistry, the birth of the latter half of the eighteenth century, grew apace, and soon found herself face to face with the great problems which Biology had vainly tried to attack without her help. The discovery of oxygen led to the laying of the foundations of a scientific theory of respiration, and to an examination of the marvellous interactions of organic substances with oxygen. The presence of free oxygen appeared to be one of the conditions of the existence of life, and of those singular changes in organic matters which are known as fermentation and putrefaction. The question of the generation of the infusory animalcules thus passed into a new phase. For what might not have happened to the organic matter of the infusions, or to the oxygen of the air, in Spallanzani's experiments? What security was there that the development of life which ought to have taken place had not been checked, or prevented, by these changes?

The battle had to be fought again. It was needful to repeat the experiments under conditions which would make sure that neither the oxygen of the air, nor the composition of the organic matter, was altered, in such a manner as to interfere with the existence of life.

Schulze and Schwann took up the question from this point of view in 1836 and 1837. The passage of air through red-hot glass tubes, or through strong sulphuric acid, does not alter the proportion of its oxygen, while it must needs arrest, or destroy, any organic matter which may be contained in the air. These experimenters, therefore, contrived arrangements by which the only air which should come into contact with a boiled infusion should be such as had either passed through red-hot tubes or through strong sulphuric acid. The result which they obtained was, that an infusion so treated developed no living things, while, if the same infusion was afterwards exposed to the air, such things appeared rapidly and abundantly. The accuracy of these experiments has been alternately denied and affirmed. Supposing them to be accepted, however, all that they really proved was, that the treatment to which the air was subjected destroyed *something* that was essential to the development of life in the infusion. This "something" might be gaseous, fluid, or solid; that it consisted of germs remained only an hypothesis of greater or less probability.

Contemporaneously with these investigations, a remarkable discovery was made by Cagniard de la Tour. He found that common yeast is composed of a vast accumulation of minute plants. The fermentation of must, or of wort, in the fabrication of wine and of beer is always accompanied by the rapid growth and multiplication of these *Torulæ*. Thus, fermentation, in so far as it was accompanied by the development of microscopical organisms in enormous numbers, became assimilated to the decomposition of an infusion of ordinary animal or vegetable matter; and it was an obvious suggestion that the organisms were, in some way or other, the causes both of fermentation and of putrefaction. The chemists, with Berzelius and Liebig at their head, at first laughed this idea to scorn; but, in 1843, a man, then very young, who has since performed the unexampled feat of attaining to high eminence, alike in Mathematics, Physics, and Physiology—I speak of the illustrious Helmholtz—reduced the matter to the test of experiment by a method alike elegant and conclusive. Helmholtz separated a putrefying, or a fermenting, liquid, from one which was simply putrescible, or fermentable, by a membrane, which allowed the fluids to pass through and become intermixed, but stopped the passage of solids. The result was that, while the putrescible, or the fermentable, liquids became impregnated with the results of the putrescence, or fermentation, which was going on on the other side of the membrane, they neither putrefied (in the ordinary way) nor fermented; nor were any of the organisms which abounded in the fermenting, or putrefying, liquid generated in them. Therefore, the cause of the development of these organisms must lie in something which cannot pass through membrane; and as Helmholtz's investigations were long antecedent to Graham's researches upon colloids, his natural conclusion was that the agent thus intercepted must be a solid material. In point of fact, Helmholtz's experiments narrowed the issue to this: that which excites fermentation and putrefaction, and at the same time gives rise to living forms in a fermentable, or putrescible, fluid, is not a gas and is not a diffusible fluid; therefore, it is either a colloid, or it is matter divided into very minute solid particles.

The researches of Schroeder and Dusch, in 1854, and of Schroeder alone, in 1859, cleared up this point by experiments which are simply refinements upon those of Redi. A lump of cotton-wool is, physically speaking, a pile of many thicknesses of a very fine gauze, the fineness of the

meshes of which depends upon the closeness of the compression of the wool. Now, Schroeder and Dusch found, that, in the case of all the putrefiable materials which they used (except milk and yolk of egg), an infusion boiled, and then allowed to come into contact with no air but such as had been filtered through cotton-wool, neither putrefied nor fermented, nor developed living forms. It is hard to imagine what the fine sieve formed by the cotton-wool could have stopped except minute solid particles. Still the evidence was incomplete until it had been positively shown, first, that ordinary air does contain such particles; and, secondly, that filtration through cotton-wool arrests these particles and allows only physically pure air to pass. This demonstration has been furnished within the last year by the remarkable experiments of Professor Tyndall. It has been a common objection of Abiogenists that, if the doctrine of Biogeny is true, the air must be thick with germs; and they regard this as the height of absurdity. But Nature occasionally is exceedingly unreasonable, and Professor Tyndall has proved that this particular absurdity may, nevertheless, be a reality. He has demonstrated that ordinary air is no better than a sort of stirabout of excessively minute solid particles; that these particles are almost wholly destructible by heat; and that they are strained off, and the air rendered optically pure, by being passed through cotton-wool.

But it remains yet in the order of logic, though not of history, to show that, among these solid destructible particles, there really do exist germs capable of giving rise to the development of living forms in suitable menstrua. This piece of work was done by M. Pasteur in those beautiful researches which will ever render his name famous; and which, in spite of all attacks upon them, appear to me now, as they did seven years ago,* to be models of accurate experimentation and logical reasoning. He strained air through cotton-wool, and found, as Schroeder and Dusch had done, that it contained nothing competent to give rise to the development of life in fluids highly fitted for that purpose. But the important further links in the chain of evidence added by Pasteur are three. In the first place, he subjected to microscopic examination the cotton-wool which had served as strainer, and found that sundry bodies, clearly recognisable as germs, were among the solid particles strained off. Secondly, he proved that these germs were competent to give rise to living forms by simply sowing them in a solution fitted for their development. And, thirdly, he showed, that the incapacity of air strained through cotton-wool to give rise to life, was not due to any occult change effected in constituents of the air by the wool, by proving that the cotton-wool might be dispensed with altogether, and perfectly free access left between the exterior air and that in the experimental flask. If the neck of the flask is drawn out into a tube and bent downwards; and if, after the contained fluid has been carefully boiled, the tube is heated sufficiently to destroy any germs which may be present in the air which enters as the fluid cools, the apparatus may be left to itself for any time, and no life will appear in the fluid. The reason is plain. Although there is free communication between the atmosphere laden with germs and the germless air in the flask, contact between the two takes place only in the tube; and as the germs cannot fall upwards, and there are no currents, they never reach the interior of the flask. But if the tube be broken short off where it proceeds from the flask, and free access be thus given to germs falling vertically out of the air, the fluid which has remained clear and desert for months, becomes, in a few days, turbid and full of life.

These experiments have been repeated over and over again by independent observers with entire success; and there is one very simple mode of seeing the facts for oneself, which I may as well describe.

Prepare a solution (much used by M. Pasteur, and often called "Pasteur's solution") composed of water with tartrate of ammonia, sugar, and yeast-ash dissolved therein.* Divide it into three portions in as many flasks; boil all three for a quarter of an hour; and, while the steam is passing out, stop the neck of one with a large plug of cotton-wool, so that this also may be thoroughly steamed. Now set the flasks aside to cool, and when their contents are cold, added to one of the open ones a drop of filtered infusion of hay which has stood for twenty-four hours, and is, consequently, full of the active and excessively minute organisms known as *Bacteria*. In a couple of days of ordinary warm weather, the contents of this flask will be milky, from the enormous multiplication of *Bacteria*. The other flask, open and exposed to the air, will, sooner or later, become milky with *Bacteria*, and patches of mould may appear in it; while the liquid in the flask, the neck of which is plugged with cotton-wool, will remain clear for an indefinite time. I have sought in vain for an explanation of these facts, except the obvious one, that the air contains germs competent to give rise to *Bacteria*, such as those with which the first solution has been knowingly and purposely inoculated, and to the mould *fungi*. And I have not yet been able to meet with any advocate of Abiogenesis who seriously maintains that the atoms of sugar, tartrate of ammonia, yeast-ash, and water, under no influence but that of free access of air and the ordinary temperature, re-arrange themselves and give rise to the protoplasm of *Bacterium*. But the alternative is to admit that these *Bacteria* arise from germs in the air; and if they are thus propagated, the burden of proof, that other like forms are generated in a different manner, must rest with the assertor of that proposition.

To sum up the effect of this long chain of evidence:—

It is demonstrable, that a fluid eminently fit for the development of the lowest forms of life, but which contains neither germs nor any protein compound, gives rise to living things in great abundance, if it is exposed to ordinary air; while no such development takes place if the air with which it is in contact is mechanically freed from the solid particles, which ordinarily float in it and which may be made visible by appropriate means.

It is demonstrable, that the great majority of these particles are destructible by heat, and that some of them are germs, or living particles, capable of giving rise to the same forms of life as those which appear when the fluid is exposed to unpurified air.

It is demonstrable, that inoculation of the experimental fluid with a drop of liquid known to contain living particles, gives rise to the same phenomena as exposure to unpurified air.

And it is further certain that these living particles are so minute that the assumption of their suspension in ordinary air presents not the slightest difficulty. On the contrary, considering their lightness and the wide diffusion of the organisms which produce them, it is impossible to conceive that they should not be suspended in the atmosphere in myriads.

Thus, the evidence, direct and indirect, in favour of *Biogenesis* for all known forms of life must, I think, be admitted to be of great weight.

On the other side, the sole assertions worthy of attention are, that hermetically sealed fluids, which have been exposed to great and long-continued heat, have sometimes exhibited living forms of low organisation when they have been opened.

The first reply that suggests itself is the probability that there must be some error about these experiments, because they are performed on an enormous scale every day, with quite contrary results. Meat, fruits, vegetables, the very materials of the most fermentable and putrescible infusions are preserved to the extent, I suppose I may say, of thousands of tons every year, by a method which

* Lectures to Working Men on the Causes of the Phenomena of Organic Nature," 1863.

* Infusion of hay, treated in the same way, yields similar results but as it contains organic matter, the argument which follows cannot be based upon it.

is a mere application of Spallanzani's experiment. The matters to be preserved are well boiled in a tin case provided with a small hole, and this hole is soldered up when all the air in the case has been replaced by steam. By this method they may be kept for years, without putrefying, fermenting, or getting mouldy. Now this is not because oxygen is excluded, inasmuch as it is now proved that free oxygen is not necessary for either fermentation or putrefaction. It is not because the tins are exhausted of air, for *Vibriones* and *Bacteria* live, as Pasteur has shown, without air or free oxygen. It is not because the boiled meats or vegetables are not putrescible or fermentable, as those who have had the misfortune to be in a ship supplied with unskilfully closed tins well know. What is it, therefore, but the exclusion of germs? I think that Abiogenists are bound to answer this question before they ask us to consider new experiments of precisely the same order.

And in the next place, if the results of the experiments I refer to are really trustworthy, it by no means follows that abiogenesis has taken place. The resistance of living matter to heat is known to vary within considerable limits, and to depend, to some extent, upon the chemical and physical qualities of the surrounding medium. But if, in the present state of science, the alternative is offered us, either germs can stand a greater heat than has been supposed, or the molecules of dead matter, for no valid or intelligible reason that is assigned, are able to re-arrange themselves into living bodies, exactly such as can be demonstrated to be frequently produced in another way, I cannot understand how choice can be, even for a moment, doubtful.

But though I cannot express this conviction of mine too strongly, I must carefully guard myself against the supposition that I intend to suggest that no such thing as abiogenesis ever has taken place in the past, or ever will take place in the future. With organic chemistry, molecular physics, and physiology yet in their infancy, and every day making prodigious strides, I think it would be the height of presumption for any man to say that the conditions under which matter assumes the properties we call "vital" may not, some day, be artificially brought together. All I feel justified in affirming is, that I see no reason for believing that the feat has been performed yet.

And, looking back through the prodigious vista of the past, I find no record of the commencement of life, and, therefore, I am devoid of any means of forming a definite conclusion as to the conditions of its appearance. Belief, in the scientific sense of the word, is a serious matter, and needs strong foundations. To say, therefore, in the admitted absence of evidence, that I have any belief as to the mode in which the existing forms of life have originated, would be using words in a wrong sense. But expectation is permissible where belief is not; and if it were given me to look beyond the abyss of geologically recorded time to the still more remote period when the earth was passing through physical and chemical conditions, which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from not living matter. I should expect to see it appear under forms of great simplicity, endowed, like existing Fungi, with the power of determining the formation of new protoplasm from such matters as ammonium carbonates, oxalates and tartrates, alkaline and earthy phosphates, and water, without the aid of light. That is the expectation to which analogical reasoning leads me; but I beg you once more to recollect that I have no right to call my opinion anything but an act of philosophical faith.

So much for the history of the progress of Redi's great doctrine of Biogenesis, which appears to me, with the limitations I have expressed, to be victorious along the whole line at the present day.

As regards the second problem offered to us by Redi, whether Xenogenesis obtains, side by side with Homogenesis; whether, that is, there exist not only the ordinary living things, giving rise to offspring which run through the same cycle as themselves, but also others, producing offspring which are of a totally different character from themselves, the researches of two centuries have led to a different result. That the grubs found in galls are no product of the plants on which the galls grow, but are the result of the introduction of the eggs of insects into the substance of these plants, was made out by Vallisnieri, Reaumur, and others, before the end of the first half of the eighteenth century. The tapeworms, bladderworms, and flukes continued to be a stronghold of the advocates of Xenogenesis for a much longer period. Indeed, it is only within the last thirty years that the splendid patience of Von Siebold, Van Beneden, Leuckart, Küchenmeister, and other helminthologists, has succeeded in tracing every such parasite, often through the strangest wanderings and metamorphoses, to an egg derived from a parent, actually or potentially like itself; and the tendency of inquiries elsewhere has all been in the same direction. A plant may throw off bulbs, but these, sooner or later, give rise to seeds or spores, which develope into the original form.

A polype may give rise to Medusæ, or a pluteus to an Echinoderm, but the Medusa and the Echinoderm give rise to eggs which produce polypes or plutei, and they are therefore only stages in the cycle of life of the species.

But if we turn to pathology it offers us some remarkable approximations to true Xenogenesis.

As I have already mentioned, it has been known since the time of Vallisnieri and of Reaumur, that galls in plants, and tumours in cattle, are caused by insects, which lay their eggs in those parts of the animal or vegetable frame of which these morbid structures are outgrowths. Again, it is a matter of familiar experience to everybody that mere pressure on the skin will give rise to a corn. Now the gall, the tumour, and the corn are parts of the living body, which have become, to a certain degree, independent and distinct organisms. Under the influence of certain external conditions, elements of the body, which should have developed in due subordination to its general plan, set up for themselves and apply the nourishment which they receive to their own purposes.

From such innocent productions as corns and warts, there are all gradations to the serious tumours which, by their mere size and the mechanical obstruction they cause, destroy the organism out of which they are developed; while, finally, in those terrible structures known as cancers, the abnormal growth has acquired powers of reproduction and multiplication, and is only morphologically distinguishable from the parasitic worm, the life of which is neither more nor less closely bound up with that of the infested organism.

If there were a kind of diseased structure, the histological elements of which were capable of maintaining a separate and independent existence out of the body, it seems to me that the shadowy boundary between morbid growth and Xenogenesis would be effaced. And I am inclined to think that the progress of discovery has almost brought us to this point already. I have been favoured by Mr. Simon with an early copy of the last published of the valuable "Reports on the Public Health," which, in his capacity of their Medical Officer, he annually presents to the Lords of the Privy Council. The Appendix to this Report contains an introductory essay "On the Intimate Pathology of Contagion," by Dr. Burdon Sanderson, which is one of the clearest, most comprehensive, and well-reasoned discussions of a great question which has come under my notice for a long time. I refer you to it for details and for the authorities for the statements I am about to make.

You are familiar with what happens in vaccination. A minute cut is made in the skin, and an infinitesimal quantity of vaccine matter is inserted into the wound. Within a certain time, a vesicle appears in the place of the wound, and the fluid which distends this vesicle is vaccine matter, in quantity a hundred- or a thousandfold that which was originally inserted. Now what has taken place in the course of this operation? Has the vaccine

matter by its irritative property produced a mere blister, the fluid of which has the same irritative property? Or does the vaccine matter contain living particles, which have grown and multiplied where they have been planted? The observations of M. Chauveau, extended and confirmed by Dr. Sanderson himself, appear to leave no doubt upon this head. Experiments, similar in principle to those of Helmholtz on fermentation and putrefaction, have proved that the active element in the vaccine lymph is non-diffusible, and consists of minute particles exceeding 1-20,000th of an inch in diameter. which are made visible in the lymph by the microscrope. Similar experiments have proved that two of the most destructive of epizootic diseases, sheep-pox and glanders, are also dependent for their existence and their propagation upon extremely small living solid particles, to which the title of *microzymes* is applied. An animal suffering under either of these terrible diseases is a source of infection and contagion to others, for precisely the same reason as a tub of fermenting beer is capable of propagating its fermentation by "infection," or "contagion," to fresh wort. In both cases it is the solid living particles which are efficient; the liquid in which they float, and at the expense of which they live, being altogether passive.

Now arises the question are these microzymes the results of *Homogenesis* or of *Xenogenesis*; are they capable, like the *Torulæ* of yeast, of arising only by the development of pre-existing germs; or may they be, like the constituents of a nut-gall, the results of a modification and individualisation of the tissues of the body in which they are found, resulting from the operation of certain conditions? Are they parasites in the zoological sense, or are they merely what Virchow has called "heterologous growths?" It is obvious that this question has the most profound importance, whether we look at it from a practical or from a theoretical point of view. A parasite may be stamped out by destroying its germs, but a pathological product can only be annihilated by removing the conditions which give rise to it.

It appears to me that this great problem will have to be solved for each zymotic disease separately, for analogy cuts two ways. I have dwelt upon the analogy of pathological modification, which is in favour of the xenogenetic origin of microzymes; but I must now speak of the equally strong analogies in favour of the origin of such pestiferous particles by the ordinary process of the generation of like from like.

It is, at present, a well-established fact that certain diseases, both of plants and of animals, which have all the characters of contagious and infectious epidemics, are caused by minute organisms. The smut of wheat is a well-known instance of such a disease, and it cannot be doubted that the grape-disease and the potato-disease fall under the same category. Among animals, insects are wonderfully liable to the ravages of contagious and infectious diseases caused by microscopic *Fungi*.

In autumn, it is not uncommon to see flies, motionless upon a window-pane, with a sort of magic circle, in white drawn round them. On microscopic examination, the magic circle is found to consist of innumerable spores, which have been thrown off in all directions by a minute fungus called *Empusa muscæ*, the spore-forming filaments of which stand out like a pile of velvet from the body of the fly. These spore-forming filaments are connected with others, which fill the interior of the fly's body like so much fine wool, having eaten away and destroyed the creature's viscera. This is the full-grown condition of the *Empusa*. If traced back to its earlier stages, in flies which are still active, and to all appearance healthy, it is found to exist in the form of minute corpuscles which float in the blood of the fly. These multiply and lengthen into filaments, at the expense of the fly's substance; and when they have at last killed the patient, they grow out of its body and give off spores. Healthy flies shut up with diseased ones catch this mortal disease and perish like the others. A most competent observer, M. Cohn, who studied the development of the *Empusa* in the fly very carefully, was utterly unable to discover in what manner the smallest germs of the *Empusa* got into the fly. The spores could not be made to give rise to such germs by cultivation; nor were such germs discoverable in the air, or in the food of the fly. It looked exceedingly like a case of Abiogenesis, or, at any rate, of Xenogenesis; and it is only quite recently that the real course of events has been made out. It has been ascertained, that when one of the spores falls upon the body of a fly, it begins to germinate and sends out a process which bores its way through the fly's skin; this, having reached the interior cavities of its body, gives off the minute floating corpuscles which are the earliest stage of the *Empusa*. The disease is "contagious," because a healthy fly coming in contact with a diseased one, from which the spore-bearing filaments protrude, is pretty sure to carry off a spore or two. It is "infectious," because the spores become scattered about all sorts of matter in the neighbourhood of the slain flies.

The silkworm has long been known to be subject to a very fatal contagious and infectious disease called the *Muscardine*. Audouin transmitted it by inoculation. This disease is entirely due to the development of a fungus, *Botrytis Bassiana*, in the body of the caterpillar; and its contagiousness and infectiousness are accounted for in the same way as those of the fly-disease. But of late years a still more serious epizootic has appeared among the silkworms; and I may mention a few facts which will give you some conception of the gravity of the injury which it has inflicted on France alone.

The production of silk has been, for centuries, an important branch of industry in Southern France, and in the year 1853 it had attained such a magnitude, that the annual produce of the French sericulture was estimated to amount to a tenth of that of the whole world, and represented a money value of 117,000,000 of francs, or nearly five millions sterling, What may be the sum which would represent the money-value of all the industries connected with the working up of the raw silk thus produced is more than I can pretend to estimate. Suffice it to say that the city of Lyons is built upon French silk, as much as Manchester was upon American cotton before the civil war.

Silkworms are liable to many diseases; and, even before 1853, a peculiar epizootic, frequently accompanied by the appearance of dark spots upon the skin (whence the name of "Pébrine" which it has received), had been noted for its mortality. But, in the years following 1853, this malady broke out with such extreme violence, that, in 1856, the silk-crop was reduced to a third of the amount which it had reached in 1853; and, up till within the last year or two, it has never attained half the yield of 1853. This means not only that the great number of people engaged in silk-growing are some thirty millions sterling poorer than they might have been; it means not only that high prices have had to be paid for imported silkworm-eggs, and that, after investing his money in them, in paying for mulberry-leaves and for attendance, the cultivator has constantly seen his silkworms perish and himself plunged in ruin—but it means that the looms of Lyons have lacked employment, and that, for years, enforced idleness and misery have been the portion of a vast population which, in former days, was industrious and well to do.

In 1858, the gravity of the situation caused the French Academy of Sciences to appoint Commisioners, of whom a distinguished naturalist, M. de Quatrefages, was one, to inquire into the nature of this disease, and, if possible, to devise some means of staying the plague. In reading the Report* made by M. de Quatrefages, in 1859, it is exceedingly interesting to observe that his elaborate study of the Pébrine, forced the conviction upon his mind that, in its mode of occurrence and propagation, the disease of the silkworm is, in every respect, comparable to the cholera among mankind. But it differs from the cholera, and, so far, is a more formidable disease, in being hereditary, and

* "Etudes sur les Maladies Actuelles des Vers à Soie," p. 53.

in being, under some circumstances, contagious as well as infectious.

The Italian naturalist, Filippi, discovered, in the blood of the silkworms affected by this strange disease, a multitude of cylindrical corpuscles, each about 1-6000th of an inch long. These have been carefully studied by Lebert, and named by him *Panhistophyton*; for the reason that, in subjects in which the disease is strongly developed, the corpuscles swarm in every tissue and organ of the body, and even pass into the undeveloped eggs of the female moth. But, are these corpuscles causes or mere concomitants of the disease? Some naturalists took one view and some another; and it was not until the French Government, alarmed by the continued ravages of the malady, and the inefficiency of the remedies which had been suggested, dispatched M. Pasteur to study it, that the question received its final settlement; at a great sacrifice, not only of the time and peace of mind of that eminent philosopher, but, I regret to have to add, of his health.

But the sacrifice has not been in vain. It is now certain that this devastating, cholera-like, Pébrine is the effect of the growth and multiplication of the *Panhistophyton* in the silkworm. It is contagious and infectious because the corpuscles of the *Panhistophyton* pass away from the bodies of the diseased caterpillars, directly or indirectly, to the alimentary canal of healthy silkworms in their neighbourhood; it is hereditary, because the corpuscles enter into the eggs while they are being formed, and, consequently, are carried within them when they are laid; and for this reason, also, it presents the very singular peculiarity of being inherited only on the mother's side. There is not a single one of all the apparently capricious and unaccountable phenomena presented by the Pébrine, but has received its explanation from the fact that the disease is the result of the presence of the microscopic organism, *Panhistophyton*.

Such being the facts with respect to the Pébrine, what are the indications as to the method of preventing it? It is obvious that this depends upon the way in which the *Panhistophyton* is generated. If it may be generated by Abiogenesis, or by Xenogenesis, within the silkworm or its moth, the extirpation of the disease must depend upon the prevention of the occurrence of the conditions under which this generation takes place. But if, on the other hand, the *Panhistophyton* is an independent organism, which is no more generated by the silkworm than the mistletoe is generated by the oak on the apple-tree on which it grows, though it may need the silkworm for its development, in the same way as the mistletoe needs the tree, then the indications are totally different. The sole thing to be done is to get rid of and keep away the germs of the *Panhistophyton*. As might be imagined, from the course of his previous investigations, M. Pasteur was led to believe that the latter was the right theory; and, guided by that theory, he has devised a method of extirpating the disease, which has proved to be completely successful wherever it has been properly carried out.

There can be no reason, then, for doubting that, among insects, contagious and infectious diseases, of great malignity, are caused by minute organisms which are produced from pre-existing germs, or by Homogenesis; and there is no reason, that I know of, for believing that what happens in insects may not take place in the highest animals. Indeed, there is already strong evidence that some diseases of an extremely malignant and fatal character to which man is subject, are as much the work of minute organisms as is the Pébrine. I refer, for this evidence, to the very striking facts adduced by Professor Lister in his various well-known publications on the antiseptic method of treatment. It seems to me impossible to rise from the perusal of those publications without a strong conviction that the lamentable mortality which so frequently dogs the footsteps of the most skilful operator, and those deadly consequences of wounds and injuries which seem to haunt the very walls of great hospitals, and are, even now, destroying more men than die of bullet or bayonet, are due to the importation of minute organisms into wounds, and their increase and multiplication; and that the surgeon who saves most lives will be he who best works out the practical consequences of the hypothesis of Redi.

I commenced this Address by asking you to follow me in an attempt to trace the path which has been followed by a scientific idea, in its long and slow progress from the position of a probable hypothesis to that of an established Law of Nature. Our survey has not taken us into very attractive regions; it has lain, chiefly, in a land flowing with the abominable, and peopled with mere grubs and mouldiness. And it may be imagined with what smiles and shrugs practical and serious contemporaries of Redi and of Spallanzani may have commented on the waste of their high abilities in toiling at the solution of problems which, though curious enough in themselves, could be of no conceivable utility to mankind.

Nevertheless, you will have observed that, before we had travelled very far upon our road, there appeared, on the right hand and on the left, fields laden with a harvest of golden grain, immediately convertible into those things which the most sordidly practical of men will admit to have value—viz., money and life.

The direct loss to France caused by the Pébrine in seventeen years cannot be estimated at less than fifty millions sterling; and if we add to this what Redi's idea, in Pasteur's hands, has done for the wine-grower and for the vinegar-maker, and try to capitalise its value, we shall find that it will go a long way towards repairing the money-losses caused by the frightful and calamitous war of this autumn.

And, as to the equivalent of Redi's thought in life, how can we over-estimate the value of that knowledge of the nature of epidemic and epizootic diseases, and, consequently, of the means of checking or eradicating them, the dawn of which has assuredly commenced?

Looking back no further than ten years, it is possible to select three (1863, 1864, and 1869) in which the total number of deaths from scarlet fever alone amounted to 90,000. That is the return of killed, the maimed and disabled being left out of sight. Why, it is to be hoped that the list of killed in the present bloodiest of wars will not amount to more than this! But the facts which I have placed before you must leave the least sanguine without a doubt that the nature and the causes of this scourge will, one day, be as well understood as those of the Pébrine are now; and that the long-suffered massacre of our innocents will come to an end.

And thus mankind will have one more admonition that "the people perish for lack of knowledge;" and that the alleviation of the miseries and the promotion of the welfare of men must be sought, by those who will not lose their pains, in that diligent, patient, loving study of all the multitudinous aspects of Nature, the results of which constitute exact knowledge, or Science.

It is the justification and the glory of this great Meeting that it is gathered together for no other object than the advancement of the moiety of Science which deals with those phenomena of Nature which we call physical. May its endeavours be crowned with a full measure of success!

Section B.

ADDRESS
TO THE
CHEMICAL SECTION.

SEPTEMBER 15, 1870.

By Professor H. E. ROSCOE, Ph.D., F.R.S., President.

GENTLEMEN,—

In the midst of the excitement of the horrible war in which the two most scientific nations of the Continent are now plunged, let us endeavour to turn our thoughts into channels more congenial to the scientific inquirer; and

allow me to recount to you, as far as I am able, the peaceful victories which, since our last meeting in Exeter, have been achieved in our special department of chemistry. But first may I be permitted to draw your attention to the fact that whilst, on the one hand, we hear of professors of chemistry and their students volunteering in the humane offices of field apothecaries or hospital attendants, we learn, on the other hand, that a distinguished chemist has accepted the chairmanship of a scientific committee called together for the express purpose of employing all the resources of modern chemistry in the horrible destruction of their fellow creatures; for to what do such resources in the last instance amount, but to sudden explosion, fire, or poison? The application of such means in such an age as this cannot surely be justified in any sense either by patriotism or public duty. And yet, in spite of all this, it is, in my mind, mainly to the brotherly intercourse of those interested in science and in its applications to the arts and manufactures in different countries that we must look as the small but living fire, which, in the end, will surely serve to melt down national animosities, and to render impossible the breaking out of disasters so fatal to the progress of science and to the welfare of humanity as that of which we are now, unfortunately, the spectators.

With regard to the position of chemical science at the present moment, it will not take a careful observer long to see that, in spite of the numerous important and brilliant discoveries of which every year has to boast, we are really but very imperfectly acquainted with the fundamental laws which regulate chemical actions, and that our knowledge of the ultimate constitution of matter upon which those laws are based is but of the most elementary nature. In proof of this I need only refer to the different opinions expressed by our leading chemists, in a discussion which lately took place at the Chemical Society on the subject of the atomic theory. The president (Dr. Williamson) delivered a very interesting lecture, in which the existence of atoms was treated as "the very life of chemistry." Dr. Frankland, on the other hand, states that he cannot understand action at a distance between matter separated by a vacuous space; and, although, generally granting that the atomic theory explains chemical facts, yet he is not to be considered as a blind believer in the theory, or as unwilling to renounce it if anything better presented itself. Sir B. C. Brodie and Dr. Odling both agree that the science of chemistry neither requires nor proves the atomic theory; whilst the former points out that the true basis of this science is to be sought in the investigation of the laws of gaseous combination or the study of the capacity of bodies for heat, rather than in committing ourselves to assertions incapable of proof by chemical means. Agreeing in the main myself with the opinions of the last chemists, and believing that we must well distinguish between fact and theory, I would remind you that Dalton's discovery of the laws of multiple and reciprocal proportions—I use Dr. Odling's word—as well as the differences in the power of hydrogen replacement in hydrochloric acid, water, ammonia, and marsh gas, are facts, whilst the explanation upon the assumption of atoms is, as far as chemistry is as yet advanced, a theory. If, however, the existence of atoms cannot be proved by chemical phenomena, we must remember that the assumption of the atomic theory explains chemical facts as the undulatory theory gives a clear view of the phenomena of light. Thus, for instance, one of the most important facts and relations of modern chemistry which it appears difficult, if not impossible, to explain without the assumption of atoms, is that of isomerism. How, otherwise than by a different arrangement of the single constituent particles, are we to account for several distinct substances in which the proportions of carbon, hydrogen, and oxygen are the same? Why, for instance, should forty-eight parts by weight of carbon, ten of hydrogen, and sixteen of oxygen united together, be capable of existing as three different chemical substances unless we presuppose a different statical arrangement of the parts by which these differences in the deportment of the whole are rendered possible? If, then, it be true that chemistry cannot give us positive information as to whether matter is infinitely divisible, and therefore continuous, or consists of atoms and is discontinuous, we are in some degree assisted in this inquiry by deductions from physical phenomena which have been recently pointed out by the genius of Sir William Thomson. He argues from four different classes of physical phenomena, and comes to the conclusion, not only that matter is discontinuous, and, therefore, that atoms and molecules do exist, but he even attempts to form an idea of the size of these molecules, and he states that in any ordinary liquid, transparent or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than the hundred millionth, and greater than the two-thousand millionth of a centimetre. Or, to form a conception of this coarse-grainedness, imagine a rain-drop or globe of glass as large as a pea, to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion; the magnified structure would be coarser-grained than a heap of small shot, but probably less coarse-grained than a heap of cricket balls.

There is, however, another class of physical considerations which render the existence of indivisible particles more than likely. I refer to the mechanical theory of gases by means of which, thanks to the labours of eminent English and German philosophers, all the physical properties of gases, their equal expansion by heat, the laws of diffusion, the laws of alteration of volume under pressure, can be shown to follow from the simple laws of mechanical motion. This theory, however, presupposes the existence of molecules, and in this direction again we find confirmation of the real existence of Dalton's atoms. Indeed, it has been proved that the average velocity with which the particles of oxygen, nitrogen, or common air are continually projected forward, amounts, at the ordinary atmospheric pressure, to 50,000 centimetres per second, whilst the average number of impacts of each of these molecules is 5000 millions per second. The mention of the molecular motions of gases will recall to the minds of all present the great loss which English science has this year sustained in the death of the discoverer of the laws of gaseous diffusion. Throughout his life Graham's aim was the advancement of our knowledge in the special subject of the molecular properties of gases. With this intent he unceasingly laboured up to the moment of his death, in spite of failing health and pressure of official business, unfolding for posterity some of the most difficult as well as the most interesting secrets of nature in this branch of our science. "What do you think," he writes to Hofmann, "of metallic hydrogen, a white magnetic metal?" And yet now, through his labours, the fact of the condensation of hydrogen in the solid state by metallic palladium, and to a less extent by other metals, has become familiar to all of us. Then, again, I would remind you of Graham's recent discovery of the occlusion of hydrogen gas in certain specimens of meteoric iron, whilst earth-manufactured iron contains not hydrogen but absorbed carbonic oxide gas, proving that the meteorite had probably been thrown out from an atmosphere of incandescent hydrogen existing under very considerable pressure, and therefore confirming in a remarkable degree the conclusions to which spectrum analysis had previously led us. The position in the ranks of British science left by Graham's death will not be easily filled up; he accomplished to a certain extent for dynamical chemistry what Dalton did for statical chemistry, and it is upon his experimental researches in molecular chemistry that Graham's permanent fame as one of England's greatest chemists will rest.

As closely connected with the above subjects, I have next to mention a most important research by Dr. Andrews, of Belfast, which, marking an era in the history of gases,

shows us how our oldest and most cherished notions must give way before the touchstone of experiment. No opinion would appear to have been more firmly established than that of the existence of three separate states or conditions of matter, viz., the solid, the liquid, and the gaseous. A body capable of existing in two or more of these states was thought to pass suddenly from one to the other by absorption or emission of heat, or by alterations of the superincumbent pressure. Dr. Andrews has shown us how false are our views on this fundamental property of matter, for he has proved that a large number of, and probably all, easily condensable gases or vapours possess a critical point of temperature at and above which no increase of pressure can be made to effect a change into what we call the liquid state, the body remaining as a homogeneous fluid; whilst below this critical temperature certain increase of pressure always effects a separation into two layers of liquid and gaseous matter. Thus, with carbonic acid, the point of critical temperature is 30·92° C., and with each given substance this point is a specific one, each vapour exhibiting rapid changes of volume and flickering movements when the temperature or pressure was changed, but showing no separation into two layers. Under these circumstances, it is impossible to say that the body exists either in the state of a gas or of a liquid; it appears to be in a condition intermediate between the two. Thus, carbonic acid, under the pressure of 108 atmospheres, and at 35·5° C., is reduced to the 1-430th of the volume which it occupies at one atmosphere, it has undergone a regular and unbroken contraction, and it is a uniform fluid: if we now reduce the temperature below 31° C. the liquid condition is assumed without any sudden change of volume or any abrupt evolution of heat. We can scarcely too highly estimate the value of the researches of Andrews.

As examples of the power which modern methods of research give of grappling with questions which only a few years ago were thought to be insoluble, I may quote the beautiful observations, now well known, by which Lockyer determined the rate of motion on the sun's surface, together with those of Frankland and Lockyer respecting the probable pressure acting in the different layers of the solar atmosphere; and lastly, the results obtained by Zöllner, respecting solar physics, and espepecially the probable absolute temperature of the sun's atmosphere, as well as that of the internal molten mass. These last results are so interesting and remarkable as being arrived at by the combination of recent spectroscopic observation with high mathematical analysis, that I may perhaps be permitted shortly to state them. Starting from the fact of the eruptive nature of a certain class of solar protuberences, Zöllner thinks that the extraordinary rapidity with which these red flames shoot forth proves that the hydrogen of which they are mainly composed must have burst out from under great pressure; and if so, the hydrogen must have been confined by a zone or layer of liquid from which it breaks loose. Assuming the existence of such a layer of incandescent liquid, then applying to the problem the principles and methods of the mechanical theory of gases, and placing in his formulæ the data of pressure and rate of motion as observed by Lockyer on the sun's surface, Zöllner arrives at the conclusion that the difference of pressure needed to produce an explosion capable of projecting a prominence to the height of 3·0 minutes above the sun's surface, a height not unfrequently noticed, is 4,070,000 atmospheres. This enormous pressure is attained at a depth of 139 geographical miles under the sun's surface, or at that of 1-658th part of the sun's semi-diameter. In order to produce this gigantic pressure the difference in temperature between the enclosed hydrogen and that existing in the solar atmosphere amounts to 74,910° C. In a similar way Zöllner calculates the approximate absolute temperature of the sun's atmosphere, which he finds to be 27,700° C.—a temperature about eight times as high as that given by Bunsen for the oxyhydrogen flame, and one at which iron must exist in a permanently gaseous form.

Passing on to more purely chemical subjects, we find this year signalised by the re-determination of a most important series of chemical constants, viz., that of the heat of chemical combination, by Julius Thomsen, of Copenhagen. This conscientious experimentalist asserts that the measurements of the heat evolved by neutralising acids and bases hitherto considered most correct, viz., those made with a mercury calorimeter by Favre and Silbermann, differ from the truth by 12 per cent, whilst the determination by these experimenters of the heat of solution of salts is frequently 50 per cent wrong. As the result of his numerous experiments, Thomsen concludes that when a molecule of acid is neutralised by caustic alkali the heat evolved increases nearly proportionally to the quantity of alkali added until this reaches 1, ½, ⅓, or ¼ of a molecule of alkali, according as the acid is mono-, di-, tri-, or tetra- basic. Exceptions to the law are exhibited by silicic, and also partly by boracic, orthophosphoric, and arsenic acids. In the two latter the heat of combination is proportional for the two first atoms of replaceable hydrogen, but much less for the third atom. A second unexpected conclusion which Thomsen draws from his calorific determinations is that sulphuretted hydrogen is a mono-basic acid, and that its rational formula is therefore HSH.

Another important addition made to chemistry since our last meeting is a new, very powerful, and very simple form of galvanic battery, discovered, though not yet described, by Bunsen. In this second Bunsen's battery only one liquid, a mixture of sulphuric and chromic acids, and, therefore, no porous cells, are employed. The plates of zinc and carbon can all be lowered at once into the liquid and raised again at will. The electromotive force of this battery is to that of Grove—the most powerful of known forms—as 25 to 18; it evolves no fumes in working, and can be used for a very considerable length of time without serious diminution of the strength of the current, so that Bunsen writes me that no one who has once used the new battery will ever think of again employing the old forms. I had hoped to be able to exhibit to the section this important improvement in our means of producing a strong current, but war has demanded the use of other batteries, and Bunsen has been unable to send me a set of his new cells.

Amongst the marked points of interest and progress in inorganic chemistry during the past year, we have to notice the preparation of a missing link amongst the oxysulphur acids by Schützenberger. It is the lowest known, and may be called hydrosulphurous acid, H_2SO_2. The sodium salt, $NaHSO_2$, is obtained by the action of zinc on the bisulphite; as might be expected, it possesses very powerful reducing properties, and bleaches indigo rapidly. The metallic vanadates have also been carefully examined, and the existence of three distinct series of salts proved, corresponding to the phosphates, viz., the ortho or tribasic vanadates, the pyro or tetrabasic vanadates, and the meta or monobasic vanadates. Of these the ortho salts are most stable at a high temperature, whilst, at the ordinary atmospheric temperature, the meta salts are most stable. In the phosphorus series, as is well known, the order of stability is the reverse; and thus the points of analogy and of difference between phosphorus and vanadium become gradually apparent.

As an illustration of the results of modern organic research—for in viewing the year's progress in this ever widening branch of chemistry it is impossible to do more than give a few illustrations—I may quote Baeyer's remarkable investigations on mellitic acid. Originally discovered by Klaproth in honeystone or mellite (a substance which yet remains the only source of the acid), mellitic was supposed to be a four-carbon acid. Baeyer has quite recently shown that the acid contains twelve atoms of carbon, or has a molecular weight three times as great as was originally supposed. He has shown that mellitic acid is benzolhexacarbonic acid, $C_{12}H_6O_{12}$, or

benzol in which the six atoms of hydrogen are replaced by the monad radical, carboxyl (COOH); as benzoic is benzol-mono-carbonic acid, or benzol in which one of hydrogen is replaced by carboxyl. The most interesting portion of Baeyer's research, however, lies in the intermediate acids, partly new and partly acids already prepared, which he has shown lie between mellitic and benzoic acid, and in which from one to six atoms of hydrogen in benzol are respectively replaced by carboxyl. Nor is this all, for he has proved that, with two exceptions, each of these six acids is capable of existing in three isomeric modifications, thus giving us an insight into the arrangement of the molecule of these aromatic compounds. For the simplest mode of explaining these numerous isomers is that given by Baeyer in the different order in which the several atoms of hydrogen in the benzol molecule are replaced. Thus, in the first, or ortho, series, the hydrogen atoms in benzol, being numbered in regular succession, are replaced in the same regular succession; in the second, or meta, series, the order is 1, 2, 3, 5, &c.; whilst the third, or para, series, take open order, as 1, 2, 4, 5, &c. Thus we have—

	Ortho series.	Para series.	Meta series.
$C_{12}H_6O_{12}$ Hexabasic	Mellitic or Benzolhexacarbonic.		
$C_{11}H_6O_{10}$ Penta ..	Unknown.		
$C_{10}H_6O_8$ Tetra ..	Pyromellitic or Benzoltetracarbonic.	Isopyromellitic.	Unknown.
$C_9H_6O_6$ Tri	Trimesinic or Benzoltricarbonic.	Hemimellitic.	Trimellitic.
$C_8H_6O_4$ Di	Phthalic or Benzoldicarbonic.	Isophthalic.	Tetrephthalic.
$C_7H_6O_2$ Mono.. ..	Benzoic or Benzolmonocarbonic.		

Amongst the most interesting series of new organic bodies are those in which tetrad silicon partly replaces carbon. Our knowledge of these substances is gradually becoming more complete; the last new member prepared by Friedel and Ladenburg is silico-propionic acid—

$$\begin{matrix} C_2H_5 \\ SiO_2H \end{matrix}$$

the first of a series of carbo-silicic acids containing the radical SiO_2H. The interesting researches of Matthiessen and Wright on morphine and codeine have thrown a new light on the constitution of these opium alkaloids. Treated with hydrochloric acid morphine loses one molecule of water, and gives rise to a new base called apomorphine, thus:—

$$\underbrace{C_{17}H_{19}NO_3}_{\text{Morphine.}} = H_2O + \underbrace{C_{17}H_{17}NO_2}_{\text{Apomorphine.}},$$

which differs in a remarkable manner from morphine, both in its chemical and physiological actions, being soluble in alcohol, ether, and chloroform, whereas morphine is nearly insoluble, and acting as the most powerful emetic known, one-tenth of a grain producing vomiting in less than ten minutes. Codeine, which only differs from morphine by CH_2 also yields apomorphine on treatment, at a high temperature with hydrochloric acid, methyl chloride being at the same time eliminated.

An important application of the dehydrating and carbon condensing power of zinc chloride, long known in its action on alcohol to produce ether, has been made by Kekulé in the reduplication of aldehyde to form croton aldehyde with loss of water—$2(C_2H_4O) - H_2O = C_4H_6O$. This croton aldehyde is also probably formed as an intermediate product in the manufacture of chloral from aldehyde, and gives rise to the formation of croton chloral, $C_4H_3Cl_3O$.

The discovery of the sedative properties of chloral hydrate by Liebreich marks an era in medical chemistry second only to the discovery of the anæsthetic properties of chloroform. Chloral not only combines with water to form a solid hydrate but also forms solid alcoholates; but these bodies appear to possess quite different medicinal properties from the hydrate, and it is important that no alcoholate should be present in the official preparation.

The chemistry of colouring matters has lately received an enormous impetus in the practical working of the brilliant discovery of the production of artificial alizarine, the colouring matter of madder, by Messrs. Graebe and Liebermann. This discovery, announced at our last meeting, is of the highest importance—whether we regard its scientific interest or its practical and commercial value—and it differs from all the former results which have been brought about by the application of science to the production of colouring matter, inasmuch as this has reference to the artificial production of a natural vegetable colouring substance, which has been used as a dye from time immemorial, and which is still employed in enormous quantities for the production of the pink, purple, and black colours which are seen everywhere on printed calicoes. During the past year much progress has been made in the practical working of the processes by which this colouring matter is obtained from the hydrocarbon anthracene contained in coal tar, and new and more economical plans for effecting the transformation have been independently proposed by Perkin and Caro, and Schorlemmer and Dale. The theoretical investigation of the reaction—and especially of the nature of some other peculiar products formed in addition to alizarine, which render the artificial colouring matter different from natural alizarine—has been carried out by Mr. Perkin, and especially by Dr. Schunck. As we are promised papers on this subject from both these gentlemen, I need not at present enter further into these interesting questions.

The surest proof of perfection in a manufacture is the degree in which the waste products are utilised, and in which the processes are made continuous. One by one the imperfections of the original discovery are made to disappear, and the products which were wasted become sources of profit, whilst in many cases their utilisation alone renders possible the continuance of the manufacture in the midst of a rapidly increasing district. The section will have the opportunity of inspecting the practical working of at least two of the most valuable of these new processes which have lately been introduced into our most important chemical manufacture—that of alkali. The first of these has been at work for some time, it is that of the recovery of sulphur from the vat waste, that *bête noir* of the alkali makers and of their neighbours. Dr. Mond has now, I believe, satisfactorily solved the difficult problem of economically regaining the sulphur by oxidising the insoluble monosulphide of calcium in the lixiviating vat itself to the soluble hyposulphite, and decomposing this by hydrochloric acid when all the sulphur is deposited as a white powder. The second of these discoveries relates to the recovery or regeneration of the black oxide of manganese used for the evolution of chlorine in the manufacture of bleaching powder. This subject has long attracted the attention of chemists, and a feasible, though somewhat costly, process, that of Dunlop, has been at work for some time at Messrs. Tennant's work at St. Rollox. During the last year a very beautifully simple and economical process proposed by Mr. Weldon, and first successfully carried out on a practical scale at Messrs. Gamble's works at St. Helens, has quickly obtained recognition, and is now worked by more than thirty-seven firms throughout the kingdom. The principle upon which this process depends was explained by Mr. Weldon at the Exeter meeting. It depends on the fact that although when alone the lower oxides of manganese cannot be oxidised by air and steam under the ordinary pressure to the state of bioxide, yet that this is possible when one molecule of lime is present to each molecule of oxide of manganese. The manganous oxide is precipitated from the still liquors with the above excess of lime, and by the action of steam and air on this, a black powder, consisting of a compound of manganese, dioxide and lime, MnO_2CaO, or calcium manganite, is formed. This, of course, is capable of again generating chlorine on addition of hydrochloric acid, and thus the chlorine process is made continuous with a working loss of only 2½ per cent of manganese. The section wil have the advantage of seeing Mond's

process at work at Messrs. Hutchinson's, and Weldon's process at Messrs. Gaskell, Deacon, and Co., at Widnes. A third process, which may possibly still further revolutionise the manufacture of bleaching powder, is the direct production of chlorine from hydrochloric acid without the use of manganese at all. In presence of oxygen and of certain metallic oxides, such as oxide of copper, hydrochloric acid gas parts at a red heat with all its hydrogen, water and chlorine being formed. This interesting reaction is employed by its discoverer, Mr. Deacon, for the direct manufacture of bleaching powder from the gases issuing directly from the salt-cake furnace. Air is admitted together with hydrochloric acid gas, and the mixture is passed over red-hot bricks, impregnated with copper salt. The oxide of copper acts as by contact and remains unaltered, whilst the chlorine, watery vapour, and excess of air pass at once into the lime chamber. There are many practical difficulties in working this process, some of which have still to be overcome, but I believe we shall hear from Mr. Deacon that, notwithstanding this drawback, he has accomplished his end of making good bleaching powder by this process.

GERMAN CHEMICAL SOCIETY OF BERLIN.

THE Editor has just received the following letter and communication from Dr. Hofmann. No introductory remarks from us are needed to urge the vital importance of a liberal and speedy response to this appeal of the German chemists to their English brethren.

MY DEAR MR. CROOKES,—Could you find space for the annexed appeal in your columns. If you were to introduce the subject by some prefatory remarks, you would greatly oblige—Yours most sincerely,

A. W. HOFMANN.

Berlin, September 11th, 1870.

The encampments of our armies in the present war; the fortresses where enormous numbers of troops, many of them badly fed and wounded, are crowded within spaces altogether inadequate; the hospitals, lastly, which, to satisfy the pressing demand, are rapidly being established all over Germany, Alsace, and Lorraine, are apt to become the hotbeds of all sorts of contagious poison. A host of new enemies threaten to arise from these places, in the form of fever and diseases of every description; and to the sudden terror of battle will be added the formidable burden of protracted suffering, unless the precautionary measures which science suggests be adopted with the utmost speed and to the fullest extent.

Animated by the desire to avert, as far as possible, such calamities, the Council of the German Chemical Society of Berlin have associated themselves with the Central Committee for the Relief of Sick and Wounded Soldiers in the Field, and now appeal to all chemical manufacturers for help in procuring an early supply of disinfectants on a very scale.

With the view of accomplishing this object, the Council of the German Chemical Society venture to hope that also many of the British manufacturers may feel disposed to co-operate with them, by placing at their disposal, either in one delivery or by regular instalments, a supply of the undermentioned disinfectants.

By order of the Council,

A. W. HOFMANN.

All communications to be adressed to Professor Hofmann, care of Dr. Wichelhaus, 33, Georgen Str., Berlin.

List of Disinfectants.

1. Liquid residues of the manufacture of chlorine.
2. Chloride of lime.
3. Green vitriol.
4. Permanganate of potash.
5. Carbolic acid (crude and purified).

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, September 5, 1870.

Most of the original memoirs and papers published in this number refer to natural history and mathematical subjects; those relating to physico-chemical matters are the following:—

Mariotte's Theory of Barometrical Oscillations.—W. de Fonvielle.—The author states that, at page 161 of the first volume of the "Oeuvres de Mariotte," published at Paris in 1740, the following ingenious theory is propounded, with the view to explain why the mercury in a barometer-tube rises with a prevailing northerly wind, and falls when it blows from the south-east. "The action of the north and north-east wind is not simply due to the fact that they render the air heavier (no doubt in consequence of its contraction by cold—*W. de F.*), but also because they blow against the globe, in the direction of from top to bottom; and, by thus compressing the air, increase its elasticity, whereby the mercury is lifted up. The barometric oscillations which are observed when a southerly or south-west wind prevails are explained on an analogous principle, viz.:—The south and south-west winds coming from afar blow towards the globe in a tangential direction, thereby lifting the upper layers of the air, and consequently diminishing its elasticity below, and thereby causing the mercury in the barometer-tube to fall."

Chemical Composition of Nadorite.—M. Flajolot.—The author has made a new series of analyses of this mineral, which he now finds to have the following percentical composition:—Lead, 51·60; antimony, 32·25; oxygen, 8·00; chlorine, 8·85. Formula, $Sb_2O_3Cl.2PbO$. The mineral may be considered to consist of a combination of oxide of lead and oxychloride of antimony—viz., 55·6 of oxide of lead and 43·4 of oxychloride of antimony, Sb_2O_3Cl.

Essay on the Venom of Scorpions.—Dr. Jousset.—This lengthy memoir contains the detailed account of a series of experiments on the venom of the *Scorpio occitanus*, a rather common *Arachnida* in Southern Europe. The author draws, from his experiments, the following conclusions:—The venom of the *Scorpio occitanus* acts directly and solely upon the red blood globules. This action consists in withdrawing from the globules their property of gliding over each other. By losing this property, the blood globules become glued together, and, by thus becoming an adhesive mass, obstruct the circulation of blood in the capillary portion of the vascular system, thereby causing a stasis which is altogether incompatible with the proper conditions of life. The author also observes that, since the action of the scorpion's venom is purely chemical, and that a certain quantity of it (the venom) is required for exerting its action, it essentially differs from virus, which acts as a ferment.

Gunpowder Prepared with Chlorate of Potassa.—M. Zaliwski.—The author proposes to render this powder fit for fire-arms, by mixing with it some finely-pulverised oxalic acid. The manufacture of gunpowder wherein, instead of the whole or part of the nitre, chlorate of potassa was introduced was tried in France as far back as the year 1788, at Essone, by the advice of M. Berthollet; but, at the first trial of mixing the materials (sulphur, charcoal, and chlorate of potassa), a tremendous explosion took place, whereby several people were killed. Afterwards (1793), some of this powder was successfully prepared, and tried in fire-arms, but it was found to be dangerous, in consequence of its great tendency to explode, by slight concussion even; and its action is comparable to that of the fulminates, which, as is well known, are not at all suitable to serve as substitutes for powder. The author's idea of rendering chlorate of potassa gunpowder fit for use, by the addition of pulverised oxalic acid, will be further investigated by a committee of scientific men.

Moniteur Scientifique, No. 329, September 1, 1870.

This number contains the following original matter relating to chemistry and collateral sciences:—

Detection of Strychnia in Medico-Forensic Analysis.—Dr. Weyrich.—The author relates, at great length, a case of poisoning, with strychnia, of a person accustomed to consume opium, and to whom had been given large doses of ipecacuanha, while, moreover, a portion of the contents of the intestines had to be tested for mineral poisons. The real bearing, therefore, of this case turns upon the detection of strychnia in the presence of emetine and morphia. The strychnia was detected in an alcoholic extract of the materials taken from the corpse, by means of the reaction produced by strong sulphuric acid and bichromate of potassa, which at first oxidises only the emetine, and, this having been removed, produces the well-known purple colours

tion, due to the action of the bichromate and sulphuric acid upon strychnia. The morphia was detected in a separately-made amyl-alcoholic solution, by means of molybdate of soda in dissolved concentrated sulphuric acid.

Detection of the Adulteration of Quinine with Salicine.—Dr. Sonelén.—The author has comparatively tested the degree of accuracy and sensitiveness of the different tests in use for the detection of the presence of salicine in quinine, which, if made with the view of fraudulent adulteration, will always be at least at the rate of 1 per cent of salicine, or more, because less will not pay. The author employed three kinds of sulphuric acid—viz., the fuming, pure concentrated acid, free from arsenic and nitric acid; ordinary concentrated sulphuric acid of commerce, containing a trace of nitric acid; and, lastly, sulphuric acid to which, purposely, nitric acid had been added. A watch-glass having been placed on a sheet of white paper, and a drop or two of the acids above referred to (each in a separate glass) having been poured therein, a few crystals of the alkaloid (sulphate of quinine) were put on the acid; if pure, there is no colouration, but, even with 1-100th of salicine, the three first-named acids caused a distinct red colouration, which did not ensue with the acid containing nitric acid. This latter acid was not even coloured by pure salicine.

Permeability of the Skin for Liquids.—Dr. Bloch.—The author describes a series of experiments made with divers fluids, none of which could exert any chemical or physical action upon the skin. Bordeaux wine, having been experimented with, was found to have penetrated the skin of the arm, washed and wiped dry, after it had been immersed for one hour in the wine, since, on washing the arm with a weak solution of perchloride of iron, the skin was black-coloured, owing to the formation of a tannate. The author seems to have forgotten that the permeability of the skin for liquids is employed in medicine as a therapeutic agent. We recollect the case of a lady who bathed in chicken broth twice daily, for therapeutic purposes; and milk, also, is in this way introduced into, and absorbed by, the system.

Zeitschrift für Chemie von Beilstein, No. 13, 1870.

This number contains the following original papers and memoirs:—

Analysis of the Water of Two Mineral Springs situated in the Neighbourhood of Cairo (Egypt).—Dr. C. Bender.—Water from Ain-Syra contains, in 1000 grms., 11·892 grms. of solid matter and 0·048 grms. of free carbonic acid gas. The solid matter, in grammes, is—Chloride of calcium, 0·150; chloride of magnesium, 1·850; chloride of sodium, 5·963; sulphate of lime, 0·500; sulphate of magnesia, 3·420; carbonate of lime, 0·004; carbonate of protoxide of iron, 0·005; traces of alumina and organic matter. Water from Hélonan; temperature, 29°; yield, 60 cubic metres in twenty-four hours. 1000 grms. contain:—Gases—Sulphuretted hydrogen, 0·044; free carbonic acid, 0·012; nitrogen, a trace. Solid substances, in grms.—Chloride of calcium, 0·180; chloride of magnesium, 1·820; chloride of sodium, 3·200; sulphate of lime, 0·024; carbonate of lime, 0·050; organic matter, a trace.

Action of Pentabromide of Phosphorus upon Azoxybenzide.—A. Werigo.—The author, desirous of substituting bromine for the oxygen contained in azoxybenzide, caused pentabromide of phosphorus to act upon azoxybenzide, and obtained (care being taken to moderate the violence of the reaction which takes place) a yellow-coloured crystalline substance, $C_{12}H_{10}N_2Br_2$. This body is, however, very unstable, so that it is even partly decomposed while being dissolved in sulphide of carbon, as well as in alcohol. By careful manipulation, the author was enabled to ascertain that the body referred to fuses at 70°, and then becomes deep red-coloured, but, on cooling reassumes its former yellow colour. Finely-divided silver withdraws the bromine from this compound, leaving azobenzid.

On Brom-Benzol-Sulphochloride, its Derivatives; and on the Position Hydrogen Occupies in Benzol.—H. Hübner and L. Alsberg.—The authors describe—Brombenzol-sulphochloride, $C_6H_4BrSO_2Cl$, a beautifully-crystalline compound, fusing at about 76°. Monobrombenzol-sulphohydrate, C_6H_4BrSH; volatile when carried by steam; soluble in boiling alcohol; crystalline akin to naphthaline; fuses at 75°; precipitated from its alcoholic solution by acetate of lead. Monobrombenzol-disulphide—

$$\left.\begin{matrix}C_6H_4BrS\\C_6H_4BrS\end{matrix}\right\}$$

fuses at 93·5, is very difficultly soluble in alcohol, and not precipitated by acetate of lead. Benzol-sulphohydrate, C_6H_5SH; a liquid boiling at about 167°; highly refracting light; smelling like mercaptan.

Sulpho-Acids and Sulpho-Hydrates derived from Crystallised Bromotoluol.—H. Hübner and J. Post.—This paper contains a lengthy enumeration of α, β, and γ series of sulpho-salts of bromotoluol, and the lengthy review of the toluol-sulpho hydrates obtained from α and β bromotoluolsulpho acid.

Preparation of Naphthœ Acid on the Large Scale.—V, Merz and H. Mühlhäuser.—The authors describe, at great length, a series of experiments, chiefly instituted with the view to obtain naphthœ acid by a cheap and expedient process readily executable on the large scale, so as to produce, from naphthaline, the acid referred to, in sufficient quantities to employ that acid industrially instead of benzoic acid. The process of preparation is, briefly, the following:—Sulpho-naphthalates, best alkaline, are distilled with cyanide of potassium, and the product of that distillation is saponified, yielding about four-fifths of its weight of naphthœ acid, which, however, requires a rather lengthy and tedious process of purification.

Preliminary Notice on the Action of Phosgen upon some of the Amides.—E. Schmidt.—When fluid phosgen acts, at 100°, upon urea, there is obtained a compound which the author calls carbonyl-dicarbamide, according to the formula—

$$2\begin{pmatrix}NH_2\\CONH_2\end{pmatrix}+COCl=\left\{\begin{matrix}CO\left\{\begin{matrix}NH_2\\NH\end{matrix}\right.\\CO\left\{\begin{matrix}NH\\NH_2\end{matrix}\right.\end{matrix}\right\}CO+2ClH.$$

When this body is again heated, along with phosgen, up to 160°—170°, there is formed dicyanic acid; when phosgen acts upon benzamide, at about 165°, there are formed benzoyl-chloride, benzo-nitrile, kyaphenin, carbonic acid, and chloride of ammonium.

On Allyl-Cyanide.—A. Rinne and B. Tollens.—The authors confirm the statements made by MM. Kekulé, Gautier, and others, as regards the reaction which takes place when chloride of allyl, dissolved in allylic alcohol, is put, along with cyanide of potassium, in a sealed tube, and heated to 100°. When the chloride of allyl, not in allylic alcoholic solution, is heated, in a sealed tube, to a higher temperature, a fluid is obtained which boils between 100° and 120°, but which has not been further investigated, since the authors only operated upon small quantities of material, and intend extending and continuing these researches.

New Derivatives from Toluol.—A. Heyneman.—The author describes paraiodmeta-nitrotoluol, nitrate of paraiodmeta-toluidine, parabromometa-toluidine, binitro-iodkresol, and parabrom-nitro-toluol.

Polytechnisches Journal von Dingler, second number for July, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Power of Electro-Magnets for Lifting Weights.—Dr. A. von Waltenhofen.—The author describes a series of experiments, instituted with the view of elucidating the question of the hitherto-conflicting results obtained in reference to the relation the lifting power of an electro-magnet bears to the force of the electric current. The experiments made by the author lead to the result that a retention, or keeping back, of lifting power, after the electric current has ceased to act, does set in with forces of currents which are within the limits of the Lenz-Jacobi's law; while, on the other hand, a forerunning (Vozeilen) of lifting power is limited to, comparatively, very weak currents.

Electro-Magnetic Behaviour of Discontinuous Masses of Iron; and—

Description of an Apparatus for Demonstrating the Magnetical Behaviour of Iron Tubes—By the same author as the first-named paper—Are memoirs illustrated with engravings.

Contribution to the History of Continuous Annular-Shaped Brick-Kilns.—P. Loeff.—With engravings.

Santorin Earth.—Dr. G. Feichtinger.—The material known as Santorin earth is a native product of the Island of Santorin, situated in the Mediterranean Sea, and part of the Greek territory. This earth, dried at 100°, consists, in 100 parts, of:—*a.* (substances soluble in water)—Sulphate of lime, 0·05; chloride of sodium, 0·05. *b.* (soluble in hydrochloric acid)—Alumina, 1·36; peroxide of iron, 1·41; lime, 0·40; magnesia, 0·23; silica, 3·40. *c.* (insoluble in hydrochloric acid)—Silica, 66·37; alumina, 12·36; peroxide of iron, 2·90; lime, 2·58; magnesia, 1·06; potassa, 2·83; soda, 4·22; water (only eliminable at low red heat), 4·06—Total, 99·83. The substance alluded to is used, along with lime, to form an excellent hydraulic cement; and the bulk of the contents of this paper are devoted to quote a series of researches bearing upon the subject of the hydraulic cements.

Estimation of Sulphur, Phosphorus, and Silicium present in Pig-Iron.—Dr. E. Richters.—This paper contains a comparative review of the relative values of the methods of Lippert and Gintl for the quantitative estimation of the substances referred to. The methods alluded to are fully described in the last edition of Fresenius's excellent work. The result of the author's researches is that Gintl's method is excellent for sulphur and phosphorus, but gives the silicium rather too low.

Manufacture of Spirit from Moss and Lichens.—S. Stenberg and T. Stahlschmidt.—This subject is by no means unimportant, since it may lead to the substitution for grain (if not completely, at least partly), as spirit-yielding material, of the abundance of mosses and lichens found in wild state on land, as well as in the sea. This lengthy paper contains a full description of the process of converting the cellulose and starch present in the raw materials into glucose.

Preparation of Beer so as to make it Fit for Long Journeys by Sea.—Dr. E. Dingler.—This essay is illustrated with engravings.

Spontaneous Combustion of Black-Dyed Silk.—Dr. E. Dingler.—A short time ago, a fire broke out at the premises of MM. Behague and Paxer, Paris, who are wholesale silk mercers; the fire was, however, very quickly discovered, and this gave rise to the discovery that it originated inside a large parcel of black-dyed silk which had been returned from the dye-house only twenty-four hours previously. That black-dyed silk is rather liable to spontaneous combustion, has been a well-known fact for years, but, notwithstanding the researches of Persoz and others on this subject, the real cause is not quite elucidated. It is advisable, however, not to keep large quantities of black-dyed silk together, and, also, to prevent it getting very dry; and, above all, care should be taken to prevent it being exposed to any great degree of heat, while proper ventilation among the parcels should be also attended to.

THE CHEMICAL NEWS.

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ON THE MANUFACTURE OF CHLORINE.*

By WALTER WELDON.

AT the meeting of this Section at Exeter, last year, I had the honour to describe a process for the manufacture of chlorine by means of a perpetually regenerated reagent consisting mainly of a previously unknown compound containing the elements of peroxide of manganese and lime. At that time the process in question was at work only at two places. It had been in operation for about a year at the works of Lieut.-Colonel Gamble, at St. Helens, at whose works, and by whose very generous co-operation, the process had been wrought out; and it has just begun to be adopted by Messrs. Gaskell, Deacon, and Co., at Widnes. It is now in operation at ten works in this country; in a few weeks it will be in operation in sixteen works in this country; at eight or nine other works in this country the erection of plant for it has either already begun or is on the point of beginning; with the exception of a very few of the very smallest, every British manufacturer of chlorine has taken a licence for the use of it; the principal continental manufacturers have done the same; and large plants for it are already completed both in France and in Germany, and, although not yet at work, would have been some time ago but for the interruption of all ordinary industrial occupations which has been occasioned in those countries by the war. In view of the extent to which this process thus has been and is being adopted, and of the probable completeness of the revolution which it is effecting in the mode of manufacturing an important commodity which is very largely produced in the district in which we are now assembled, Dr. Roscoe has suggested that I should this year submit to the Section a brief account of the practical results which the process has been found to yield under the more extended experience which we have now had of it, and of the development which it has undergone since the date of my paper of last year.

The process is performed by means of an apparatus of which I exhibit a model. The vessels comprised in this apparatus are arranged at five successive elevations, so that after having been pumped up to the highest of them the liquor operated upon can afterwards descend to all the others by its own gravity. The lowest of these vessels is a well, which is furnished with a mechanical agitator. The slightly acid chloride of manganese liquor with which the process commences runs from the stills in which it is produced into this well, and is there treated with finely-divided carbonate of lime, the action of which is facilitated by energetic agitation. When the neutralisation of the free acid which is at first contained in this liquor, and the decomposition of the sesquichloride of iron and sesquichloride of aluminium which are also at first contained in it, are completed, the liquor is pumped up into settling tanks placed nearly at the top of the apparatus, and known as the "chloride of manganese settlers." It now consists of a quite neutral mixed solution of chloride of manganese and chloride of calcium, containing in suspension considerable quantities of sulphate of lime and small quantities of oxide of iron and alumina. These solid matters rapidly deposit in the chloride of manganese settlers, leaving the bulk of the liquor perfectly bright and clear, and of a faint rose colour. The next step is to run off the clear portion of the contents of the chloride of manganese settlers into a vessel placed immediately below those settlers, and called the "oxidiser." This is usually a cylindrical iron vessel about 12 feet in diameter and about 22 feet deep. Two pipes go down nearly to the bottom of the oxidiser—a large one for conveying a blast of air from a blowing-engine, and a smaller one for the injection of steam. The latter is for the purpose of raising the temperature of the contents of the oxidiser when necessary—for sometimes the chloride of manganese liquor reaches the oxidiser sufficiently hot—to somewhere between 130° and 160° or 170° F. Immediately above the oxidiser is a reservoir containing milk of lime. The oxidiser having received a charge of clear liquor from the chloride of manganese settlers, and this liquor having been heated up to the proper point, if it was not already hot enough, blowing is begun, and milk of lime is then run into the oxidiser as rapidly as possible, until the filtrate from a sample taken at a tap placed nearly at the bottom of the oxidiser ceases to give a manganese reaction with solution of bleaching-powder. A certain further quantity of milk of lime is then added, and the blowing is then continued until peroxidation ceases to advance. That point is usually attained when from about 80 to 85 per cent of the manganese present has become converted into peroxide. The contents of the oxidiser are now a thin black mud, consisting of solution of chloride of calcium containing in suspension about two pounds of peroxide of manganese per cubic foot, these two pounds of peroxide of manganese being combined with varying quantities of protoxide of manganese and lime. This thin mud is now run off from the oxidiser into one or other of a range of settling-tanks ("mud settlers") placed below it, and is there left at rest until it has settled as far as it will, usually until about one-half of its volume has become clear. The clear part, consisting simply of solution of chloride of calcium, is then decanted, and the remainder, containing about four pounds of peroxide of manganese per cubic foot, is then ready to be used in the stills. There it reacts upon hydrochloric acid, liberating chlorine, with reproduction of exactly such a residual solution as was commenced with. With that solution the round of operations is begun again; and so on, time after time, indefinitely.

The quantity of lime which has to be put into the oxidiser before the filtrate from a sample of its contents ceases to give a manganese reaction, varies very considerably. Recently precipitated protoxide of manganese dissolves very appreciably in neutral solution of chloride of calcium, its solution therein comporting itself with reagents, exactly like solutions of manganese salts. It dissolves also in solution of oxychloride of calcium, that is to say, in solution of chloride of calcium containing dissolved lime; its solution in oxychloride of calcium *not* giving the ordinary manganese reactions. Hence, even if all portions of the lime added to the chloride of manganese in the oxidiser were capable of acting on chloride of manganese equally readily, manganese could not cease to be so in solution as to be detectible by ordinary reagents until more than an equivalent of lime had been added,—until enough had been added, that is to say, not only to decompose all the chloride of manganese, but also to form a certain quantity of oxychloride of calcium. It is never the case, however, that all portions of the lime used are capable of acting on the chloride of manganese with equal readiness. The lime used always contains a larger or smaller proportion of particles coarser than the rest, which coarser portions cannot of course act so rapidly as the finer portions; and as the decomposition of the chloride of manganese requires to he completed as quickly as possible, those portions of the lime which will not act upon it instantly are scarcely allowed time to act upon it at all. These coarser portions of the lime thus contribute very little to the decomposition of the chloride of manganese, though they afterwards dissolve completely in the hot solution of chloride of calcium, and then play their full part in the reactions which take place during the subsequent blowing. The proportion of the lime which thus does not act on the chloride of manganese varies with the source of the lime, and with the manner in which it is prepared; so that the quantity of lime which has to be added

* Read before the British Association, Liverpool Meeting, Section B.

to a charge of chloride of manganese liquor in the oxidiser before the filtrate from a sample of the resulting mixture ceases to become coloured on addition of solution of bleaching-powder, varies from about 1·15 to 1·45 equivalents. The further quantity of lime which is added after that point has been reached is now usually simple enough to raise the total quantity to about 1·5 or 1·6 equivalents, being from one-half to six-tenths in excess of the quantity which actually takes part in the decomposition of the chloride of manganese.

The results which we have latterly begun to obtain with these proportions of lime are such as our previous experience had not prepared us to expect. Until quite recently, our experience seemed to show that whatever proportions of lime we might use in the oxidiser, we could not obtain products containing less than an equivalent of base or bases per equivalent of peroxide of manganese in them. Now, however, we are regularly obtaining products containing only between 0·9 and 0·7 equivalents of base, and we have occasionally got down nearly to 0·5 equivalents of base. With respect to the conditions which determine the formation of products containing these low proportions of base, all that I can say at present is that we have begun to make these products, or at any rate to make them regularly, only since we began to considerably increase the quantity of air blown in a given time into an oxidiser of a given size. There can be scarcely any doubt now that products containing at any rate something less than an equivalent of base have been made occasionally, under special circumstance, from the very beginning; but for a long time it was only so very rarely that we seemed to get less than an equivalent of base, and the apparent proportion less than an equivalent was always so small, that we put down the apparent result—a little hastily, as it now appears—to errors of analysis. It is certain, however, that products containing appreciably less than an equivalent of base have begun to be made regularly only since manufacturers who had previously employed only one blowing-engine for the process began to use two engines, blowing with both into the same oxidiser, and since other manufacturers began to work with larger blowing-engines than had been used in the process before.

All that I can learn with respect to the composition of the new products containing less than an equivalent of base tends to show, to my mind, that there are manganites corresponding to nearly all the known carbonates. We knew last year of normal manganites, corresponding, say, to normal carbonate of calcium, and of basic manganites, corresponding to Schindler's carbonate of zinc and to Bonsdorf's carbonate of lead. I venture to believe now that there are also acid manganites, corresponding to the bicarbonates, and that sesquimanganites probably exist as well.

That hydrated peroxide of manganese, or H_2MnO_3, is as distinctly an acid as H_2CO_3, or H_2SO_3, seems to me to be shown by the fact that if free hydrated peroxide of manganese be boiled with an equivalent of protoxide of manganese, a reaction takes place between the two bodies, the product of which reaction does not absorb oxygen on treatment with air. Of course, if any free MnO remained after boiling the two bodies together, oxygen would be absorbed on subsequent treatment with air. The product is, in fact, precisely the same compound—ordinarily called "sesquioxide of manganese," and written Mn_2O_3—as that which is produced by blowing air into a mixture of protoxide of manganese and water, or in any other way exposing protoxide of manganese, by itself, to the action of the atmosphere at ordinary temperatures; and its formation in the way just stated seems to me to be exactly similar to that, say, of carbonate or of sulphite of calcium by the reaction of H_2CO_3 or of H_2SO_3 upon CaO. Apart from its being thus formed by a reaction exactly resembling the ordinary reaction of an acid upon a basic protoxide, that which is ordinarily called sesquioxide of manganese is really manganite of hydrogen in which H_2 has been replaced by Mn, and that it is thus properly manganite or manganese, or $MnMnO_3$, seems to me to follow from the circumstance that, by whatever method this body may have been produced, on treating it with solution of certain salts of other metals ordinary double decompositions occur. Thus, $MnMnO_3 + CuSO_4$ give $MnSO_4 + CuMnO_3$, and $MnMnO_3 + FeSO_4$ give $MnSO_4 + FeMnO_3$. (This latter is a very unstable body, which soon undergoes spontaneous change; but that it is formed and exists for some time I believe to be certain). Moreover, compounds in which the basic Mn of $MnMnO_3$ is replaced by other metals can be formed, not only by the reaction of $MnMnO_3$ itself upon the salts of other metals, but also by the direct reaction of nascent manganous acid upon protoxides of other metals. For example, as I stated last year, whereas if protoxide of manganese by itself be treated with air in the wet way, only one-half of it undergoes peroxidation, the other half being apparently required to furnish base to the half which becomes peroxidised, if a mixture of protoxide of manganese and an equivalent of lime be treated with air in the wet way, the whole of the protoxide undergoes peroxidation, and the lime ceases to be capable of either reacting on chloride of manganese, or of dissolving in solution of chloride of calcium. Similarly, if protoxide of manganese, suspended in solution of either baryta, strontia, soda, or potash, be treated with air, baryta, strontia, soda, or potash go out of solution, and there is formed an insoluble compound containing one equivalent of manganese, three equivalents of oxygen, and one equivalent of barium, strontium, sodium, or potassium, as the case may be.

With the existence and modes of formation of normal manganites of all these metals we were acquainted last year; what is new is the apparent formation, under the conditions of working on the large scale at which we have arrived recently, of acid manganites, or double manganites of metal and hydrogen. By far the greater number of batches containing less than an equivalent of base which have been made as yet resemble in constitution one or the other of the two representative batches, the composition of which is stated on one of the diagrams I exhibit. In one of the batches, of the total manganese operated upon 86·5 per cent had been peroxidised, and for each equivalent of peroxidised manganese present there were 0·85 equivalents of bases. Regarding the constituents of the batch, for convenience, as MnO_2, MnO, and CaO, and considering the total manganese present as a thousand equivalents, there were thus in this batch 865 equivalents of MnO_2, 135 equivalents of MnO, and 0·85 times 865, or 735 equivalent of total bases, 135 of which were MnO, the remaining 600 being CaO. Assuming that the 600 CaO were combined with 600 MnO_2, as normal manganite of calcium, there remained 265 equivalents MnO_2 and 135 equivalents of MnO, the proportion of the former to that of the latter being very nearly two to one. These figures I hold to show the existence in this batch of an acid manganite, $MnH_2(MnO_3)_2$, or a compound containing the elements of one of normal manganite of manganese and one of manganite of hydrogen. In the other batch, of the total manganese present 81·5 per cent had been peroxidised, and for each equivalent of peroxide present there were 0·885 equivalents of bases. This batch, therefore, contained 815 equivalents of MnO_2, 185 equivalents of MnO, and 536 equivalents of CaO. Assuming, as before, that all the lime existed as $CaMnO_3$, there were left 279 MnO_2 and 185 MnO. This is almost exactly three of the former to two of the latter, suggesting the existence in that batch of a sesquimanganite of manganese, containing the elements of two of normal manganite of manganese with those of one of manganite of hydrogen. In these batches, it is only acid manganites of manganese that I suppose to have existed; but one or two batches have been made, containing not much more than 0·5 equivalents of base, in which I believe that there must also have been an acid manganite of calcium. It may be, of course, that in all batches containing less than an equivalent of base a

portion of the manganous acid exists in the free state; but I have not yet met with any instance of a batch, the blowing of which I have known to have been continued until peroxidation had really ceased, and the proportion of base in which, while less than an equivalent, was such that the batch could not have consisted entirely of acid manganites, in which the peroxide remaining after deduction of the quantity equivalent to the combined lime contained in the batch was in any other proportion to the basic manganese contained in the batch than either that of two equivalents to one or that of three equivalents to two —a fact almost irresistibly suggestive of the two bodies being combined. The circumstance, moreover, that under no known conditions can peroxide of manganese be formed, by treating protoxide with air in the wet way, without some portion either of manganese itself or of some other metal going simultaneously into combination as base, strongly indicates that only salts of manganous acid can be formed in that way.

The quantity of air which requires to be blown into the oxidiser per given quantity of peroxide of manganese made varies with a considerable number of conditions, but more especially with the depth of the charge operated upon, and with the quantity of manganese contained in a given volume of it. Within all practicable limits, increase of the depth of the column blown into is equivalent to increase of the quantity of air blown; and the more particles of protoxide are contained in a given volume of the charge, the larger is the total surface which they present for the air to act upon, and the greater is the proportion of the total oxygen injected which becomes absorbed. The proportion of the oxygen absorbed to the quantity blown in being of course greatest at the commencement of the operation and afterwards continually diminishing, a time at length arriving, if the blowing be continued long enough, at which no more oxygen is absorbed at all, the proportion of the total quantity of oxygen absorbed to the total quantity blown in is also considerably influenced by how nearly to that point the operation be continued. The table accompanying shows the progress of the oxidation of three batches, made at different works, and constituting fair average examples of what takes place under the different conditions under which these three batches were respectively made. The quantities of air given are not absolutely accurate, but are very near approximations to the actual quantities. One of these three batches contained 1987 pounds of peroxide, reckoned as MnO_2, which was made in four hours, by the injection of about 240,000 cubic feet of air, being at the rate of about 120 cubic feet of air for every pound of MnO_2 made.

This batch absorbed in the first hour 12·8 per cent of the oxygen injected, in the second hour 10·5 per cent, in the third hour 8·9 per cent, and in the fourth hour 2·0 per cent; the proportion of the total quantity absorbed to the total quantity injected being 8·5 per cent. The weight of the total oxygen absorbed was 364 pounds, of which 136 pounds were absorbed in the first hour, 111 in the second hour, 95 in the third hour, and 22 in the fourth hour. In the case of the batch next represented, a deeper column was blown into, and the blowing was stopped before the peroxidation had quite ceased. This batch contained 2500 pounds of MnO_2, made in five hours, during which about 175,000 cubic feet of air were blown in, so that in this batch only 70 cubic feet of air were used per pound of MnO_2 made. The proportion of oxygen absorbed in the first hour was 20·2 per cent of the quantity blown in, in the second hour 17·5 per cent, in the third hour 16·3 per cent, in the fourth hour 13·6 per cent, and in the fifth hour 6·1 per cent; the proportion of the total quantity absorbed to the total quantity blown in being 14·8 per cent. The total quantity of oxygen absorbed was 458 pounds, of which 125 were absorbed in the first hour, 108 in the second, 101 in the third, 84 in the fourth, and 40 in the fifth. In the third batch, the column was also a deep one, and the chloride of manganese liquor commenced with was unusually strong. On the other hand, however, the blowing was continued until the peroxidation was quite completed. This batch was blown eight hours, during which 432,000 cubic feet of air were injected, and 5400 pounds of MnO_2 made, being one pound of MnO_2 per 80 cubic feet of air, and the total oxygen absorbed being 13·3 per cent of the total quantity injected.

The mechanical power expended in the injection of the air into the oxidiser has hitherto averaged between seven and eight horse-power for one hour per 100 pounds of MnO_2 made. I believe that it is capable of being considerably diminished, but that is about what it has usually been hitherto. The quantity of chlorine contained in a ton of bleaching-powder at 37 per cent is liberated by 1020 pounds of MnO_2, but, owing to the various losses of chlorine which occur in the manufacture of bleaching-powder, the quantity of manganite mud actually used per ton of bleaching-powder made by means of it is ordinarily the quantity containing about 1100 pounds of MnO_2, the production of which may be said to require the expenditure of about thirty-five to forty horse-power for two hours.

The lime used in the oxidiser has hitherto been usually prepared in the same manner as the lime used in bleaching-powder chambers; that is to say, it has been slaked with as nearly as may be only an equivalent of water, and the resulting hydrate then separated into two portions by means of very fine sieves, only the portion which passes through the sieves being used. Including the portion which is sieved out, and which, although it does not go into the oxidiser, is usually charged to the process, the consumption of lime in the process, per ton of bleaching-powder made by means of it, at present averages about 14 cwts. At one work on the Tyne, however, it has been reduced to 12 cwts.; and if we get to make regularly, as I believe we shall, products containing not much more than half an equivalent of base, it will eventually be reduced everywhere to below 10 cwts.

The quantity of acid consumed per ton of bleaching-powder made by means of manganite mud varies with the degree of care with which the process is performed and with the general skill of the manufacturer, being in some cases very considerably below the average quantity consumed in making a ton of bleaching-powder by means of native manganese, while in other cases it is scarcely at all below that quantity. I believe that a ton of bleaching-powder is never made in this country, by means of native manganese, from less than the acid from 60 cwts. of salt, and only rarely from less than the acid from between 70 and 80 cwts. of salt. At least one manufacturer, however, whose mud contains, as yet, by no means a minimum of base, and who at present follows a method of treating the mud in the stills, which is not quite the most economical of acid, is consuming, per ton of bleaching-powder made by means of manganite mud, only 170 cubic feet of acid at 24° Twaddell—a quantity which I believe to be producible, in practice, from less than 48 cwts. of salt. As what one manufacturer is doing can surely be done by all, when equally familiar with the process, I venture to believe that a very considerable economy of acid will eventually be realised by the process everywhere.

The loss of manganese which occurs in the process at present varies from about 4 per cent to about 10 per cent. The only unavoidable source of loss is that constituted by the deposit of sulphate of lime and other matters which forms in chloride of manganese settlers. These deposited matters have to be removed in the state of thin mud, largely mixed, that is to say, with solution of chloride of manganese. Unless this mud be well washed after its removal from the chloride of manganese settlers, and the washings be returned to the process, the manganese lost with this mud amounts to fully 5 per cent, or even more; but by suitable washing the manganese thrown away with the mud from chloride of manganese settlers can be reduced to below 2 per cent. The only other sources of

loss are, leakage of vessels, and the running away of mud by careless workmen with the chloride of calcium solution from the mud-settlers. The former of these sources of loss ought, practically, never to exist, and the latter is now being eliminated at several works by the chloride of calcium solution, instead of being run away directly from the mud-settler, being run first into catch-pools, in which any mud which may be run off with it from the mud-settlers is allowed to deposit.

Beyond the sulphate of lime and other bodies which are deposited in the chloride of manganese settlers, the only residual product of the process, and the only other thing which has to be thrown away, is solution of chloride of calcium. As this solution represents all the lime and all the limestone used in the process, and two-thirds of the chlorine contained in the acid employed, and as an industrial process is, of course, imperfect in proportion as anything whatever which is manipulated in it has to be simply thrown away, and especially in proportion as its yield of the commodity, the production of which is its sole object, falls below the total quantity contained in the materials used, I have tried to use, in the oxidiser, magnesia instead of lime, afterwards decomposing, by heat, the resulting chloride of magnesium into magnesia, for use over again, and hydrochloric acid. In that form, the process is capable of yielding, undiluted with other gases, all the chlorine contained in the acid employed, and, apart from mechanical loss, employs no materials which are not used over and over again, excepting coal and air. This form of the process has already stood the test of a certain amount of experience on the large scale; and I venture to believe that, when the time shall have arrived when it will be desirable to obtain, from a given quantity of hydrochloric acid, more chlorine than can be obtained therefrom by means of peroxide of manganese recovered by means of lime, peroxide of manganese recovered by means of magnesia will prove to be the reagent by which chlorine can be most economically manufactured.

ON THE UTILISATION OF SEWAGE,

WITH SPECIAL REFERENCE TO THE PHOSPHATE PROCESS.*

By DAVID FORBES, F.R.S., &c.

SINCE the universal adoption, in this country, of water as a medium for carrying off the excreta in towns, the difficulties of dealing with the sewage question, so important from a sanitary point of view, have been immensely increased, as, instead of as formerly, having to do with but a comparatively small amount of the original matter, we now have this amount diluted to several hundred times its bulk or volume, with, at the same time (at least in most cases), a proportionately still greater decrease in its agricultural value, owing to the admixture of the waste products from chemical and other manufactures, which, in themselves, are not only valueless, but frequently even highly injurious to vegetation.

As all the water, except what is carried off by evaporation, both in the excreta as well as what is added in order to float them off, must ultimately, by gravitation, find its own way to the rivers and sea, or sink into the ground to pollute the wells and springs around; and, since there is no likelihood of the employment of water being discontinued, there remains no remedy but to look this difficulty boldly in the face, and attempt to overcome it by devising some method, or rather methods (for I feel confident that no one system will be found advantageous or applicable to all local circumstances), by which the sewage may be utilised, or, at least, prevented from being, as at present, not only a nuisance, but also a source of danger, to the population around.

* Read before the British Association, Liverpool Meeting, Section B.

All the systems hitherto employed for this purpose may be classed under two heads—the purely Mechanical and the Mechanico-Chemical. Under the first, the sewage (lifted, by pumping, to a higher level when necessary) is allowed to flow directly into the nearest river or sea, to destroy the fish, pollute the stream, and carry the germs of disease to everywhere to which such contaminated water can penetrate; the only improvement in later times being, that at some places, the sewage is allowed, first, to settle, and deposit the larger portion of its solid contents, or, is passed through some species of filter, which, acting merely mechanically, keeps back the suspended particles.

Although sewage-water, so filtered, may appear perfectly clear to the eye, it hardly requires chemical analysis to show that it has not, in reality, been purified to any extent; the fœtid smell which it emits, or which is soon developed upon standing, indicates that much organic matter capable of entering into putrefaction still remains in solution; and, although such putrefaction may, in some degree, be counteracted or retarded by the use of disinfectants or antiseptics (like carbolic acid, &c.), still I think it is now generally acknowledged that the required putrefaction cannot be effected by any merely mechanical system whatever.

Coming now to the mechanico-chemical systems proposed for the utilisation of sewage, we must class sewage irrigation under this head, not because it involves (at least, as usually carried out) any direct chemical treatment of the sewage, but because this system is based upon a combination of purely mechanical filtration, the soil acting as a filter, with the chemical action brought into play by the growth of the vegetation, which decomposes and assimilates the organic matter and other available substances, both in the liquid, as well as in the solid matter of the sewage; and, provided the proper ratio be observed between the supply of sewage to the ground and the capabilities of the crops to assimilate its contents, the surplus water will drain from the land in a comparatively pure and innocuous condition; so that this system, which might be appropriately termed the natural system of sewage irrigation, if properly carried out, utilises at once both the entire liquid as well as solid contents of the sewage, and leaves nothing more to be desired, provided only that the local circumstances are favourable to its being carried out.

It must not, however, be supposed to be without its drawbacks, and there are also numerous localities where sewage irrigation does not appear to be either applicable or advantageous.

It must be remembered that the distribution of fœtid sewage water must taint the surrounding air; and when the soil does not allow the sewage to sink quickly into its substance or, especially if stiff clay or not well drained, becomes saturated with sewage, the smell may become so offensive that the neighbourhood will not submit to it; and it is no wonder that, under such circumstances, evidence has already been brought forward to prove that (for example, at Croydon) contagious fevers are either generated or become more prevalent. It is also stated that sewage irrigation is not suited for all crops, although very advantageous for some—as, for example, Italian rye-grass; so it becomes a question, also, as to whether a sufficient sale can be obtained for such crops in the neighbourhood; and in the case of one sewage-farm last year, I am informed that this was not the case. As far as present experience goes, it indicates also that the continued use of sewage over the same land ultimately tends to produce an unhealthy condition of vegetation; and certainly it appears to have been proved that a limit is soon reached beyond which the application of more sewage may even be positively injurious.

The expense for machinery, and appliances for pumping and distributing the sewage, of many large towns, especially when the sewage cannot be all brought to one centre, must often be so great as to deter companies, or even municipalities, from adopting this system; and, in many cases,

suitable land cannot be obtained at all, or only at such great distances as to still further augment this great outlay. Besides this, it must be borne in mind that the area of land required to assimilate the whole of the sewage of a town like London, or any of our great commercial centres, without becoming supersaturated, will be both extremely large, as well as costly; since the value of land in the immediate neighbourhood of large towns is, as a rule, not dependent upon the value of the crops it will furnish, but is of a fictitious but infinitely higher value for building sites, &c. As regards the area required for sewage cultivation, I was informed, on a recent visit to the sewage farm at Warwick, that, after a three years' trial of 100 acres, it was found that double this amount of land would be required, in order to fully utilise the entire sewage. Now, as Warwick has only 10,000 inhabitants, and is particularly favoured by being a strictly rural town, without any chemical or other manufactories, it would follow, at this rate, that it would require much more than 60,000 acres to absorb the sewage of London.

Fully admitting the advantages of sewage irrigation when applied in certain localities, I still believe that, taking all the above circumstances into due consideration, you will agree with me as to the importance of searching for some chemical process by which the sewage may be deodorised and purified at once—at least, to such an extent, that the supernatant water may be directly run off into the rivers or sea—without danger to health or animal life, and thus avoid the necessity of erecting costly works for the collection and transmission of the sewage to localities miles distant, where it is distributed to taint the surrounding atmosphere.

Many attempts have, as might have been expected, been already made in this direction. As early as 1845, works were erected in Edinburgh, to which I acted as chemical adviser in which the sewage was treated with lime, a process which, in later years, has been carried out at Leicester, Tottenham, and Blackburn, but which has proved a failure, in a sanitary point of view, because it did not effect a sufficient purification of the water; and, as a commercial speculation, because the precipitate or manure obtained was comparatively worthless, being actually of less value than the original deposit from the sewage itself.

The treatment of sewage with lime and chloride of iron, as used at Northampton, is a process which, although apparently an improvement upon the treatment by lime alone (at least, in so far as regards the purification of the affluent water), has also failed as a commercial success, for the same reasons.

It has been known from very ancient times, that alum has a remarkable decolourising and purifying influence on foul water, which appears to be due to the property which alumina and certain other compounds have of forming combinations with organic matter and producing compounds more or less insoluble in water, a property which has long been utilised in the arts of dyeing, the manufacture of pigments and sugar, the clarification of liquids, &c., and which of late years has been applied to the purification of sewage, the salts used being ordinary alum and crude sulphate of alumina. The purification of sewage-water so effected is, however, not considered by the Rivers' Pollution Commission to be sufficient; and the value of the precipitated deposit, when used as manure, is but little better than the mere deposit from the sewage itself.

The so-called A B C process, which has of late been prominently placed before the public in connection with the Leamington and Hastings sewage, is carried out by adding to the sewage an extraordinary mixture of clay, along with alum, blood, animal or vegetable charcoal—burnt clay, salt, magnesian limestone, and compounds of magnesia and manganese, the last five substances, if not necessary, being omitted.

The major part of the purifying mixture is the clay, and next in quantity the alum, all the other substances being added in so insignificant a proportion that they can hardly be expected to influence the result in any great degree. The chemical action of the alum has been already alluded to; but the clay seems to play a mere mechanical part, by entangling the suspended matters in the sewage, and so causing them, by its weight, to sink down or transport them to the bottom of the tank more quickly. An inspection of the working of the process at Leamington made me endorse the opinion already given by the Rivers' Pollution Commission, that it altogether failed to effect any sufficient purification of the sewage-water, or to produce a manure of such commercial value as could possibly ensure its sale at a price which could pay for its carriage to any distance beyond its immediate neighbourhood.

Having now alluded to all the principal methods which have already been tried for sewage purification and utilisation for manure, I will call your attention to an entirely novel process now brought forward by Dr. Apsley Price and myself, and which we have called the phosphate process.

This process is founded on the fact that certain mineral phosphates, easily obtainable, especially those containing alumina, when in a hydrated or freshly-precipitated state, eagerly combine with the organic matter contained in the sewage, it being sufficient merely to agitate them in the most fœtid sewage to deprive it of all its odour and colour, even if tinctorial substances of great intensity be present in the solution at the same time; whilst the phosphate of magnesia combines with the ammonia contained in the sewage, and precipitates it also in the state of the double phosphate of ammonia and magnesia.

The precipitate subsides rapidly, and the water drawn off is, as you see in the experiments here before us, quite transparent, colourless, and has so little perceptible taste, that you can drink it without repugnance if you can only banish the idea from your minds that it has only just been obtained from so filthy a source.

The process is, as you will see, an extremely simple one, and requires nothing beyond a reservoir for holding the sewage whilst it is submitted to the operation. The phosphates are preferably added, in the state of solution, in sulphuric or hydrochloric acid, to the sewage, and their precipitation, in the hydrated form, along with the organic matter in the sewage, and more or less of the ammonia (dependent on the strength of the sewage and amount of time allowed to stand), is instantaneously effected by the addition of a small quantity of milk of lime, just sufficient to neutralise the acid which holds them in solution, the deposit subsides rapidly, and the supernatant water may at once be run off and discharged into the river.

Before recommending this process for adoption, we must necessarily be prepared to answer two questions, as to—

(1) Whether the water discharged after this treatment is sufficiently pure to be permitted to flow into the rivers? And—

(2) Whether the valuable constituents of the sewage have been precipitated?

Before answering the first of these questions, another must be asked, which is—When can such water be regarded as sufficiently pure? and on this point opinions are much divided; some demanding a standard of purity as high, or even higher than many natural drinking waters, whilst others are content when the affluent water is colourless, clear, and devoid of offensive smell. As the old saying is, whilst the doctors differ the patient dies, so, in this case, we still find the most offensive sewage allowed to run into and pollute our streams, because the present processes, although certainly better than no treatment at all, have not as yet secured such an ideal standard of perfection as, practically, they are not even likely ever to attain.

As regards the phosphate process, we do not claim that the affluent process is by anything like as pure as the

water supplied for drinking purposes, but are content with showing that it is as transparent and colourless as ordinary river water: that it can be taken into the mouth, and even drunk, without repugnance; that fishes can live in it; and, most important of all, that it is not only free from any offensive smell, but, as in the specimen on the table before you, has remained for months, during the entire hot summer of this year, without showing any tendency to putrefy or emit any disagreeable odour. So that, for the above reasons, we believe that the affluent water from the phosphate process may be allowed to flow directly into the rivers, without injury either to the fish in them or the health of the inhabitants on their banks.

Coming now to the second question, I would premise by stating that I believe that the agricultural value of sewage has, in general, been much over-estimated. That the excreta may have originally represented a value of from eight to twenty shillings per head, as estimated by various writers, is not improbable; but it is as incorrect to regard the sewage as representing the same value as the original excreta as, for example, to assert that the water in a barrel into which a bottle of brandy worth 5s. had been poured as equal in value to the original brandy; and I imagine that the most inveterate toper would decline to drink off the barrel for the sake of utilising the brandy in it. The whole of the brandy could be recovered by distillation, but probably at a cost greater than its value; and this would also be the case with sewage if we attempt to extract the entire manurial contents.

Chemists are all agreed that no chemical combinations are known by which the whole of the sewage contents valuable for agriculture can be precipitated; and in our attempts, fully recognising this, we have only endeavoured to extract so much as will leave the affluent water in a condition sufficiently pure as to be innoxious. In regard to the ammonia, the phosphate process converts it into the most insoluble compound known, the double phosphate of magnesia and ammonia, and the extent to which it is recovered is dependent upon the length of time allowed for subsidence and the solvent action of the water, whilst, as before stated, the experiments already made with London sewage from Barking Creek shows that the purified sewage retains but a mere trace of organic matter.

A most important feature of the phosphate process, however—one in which it differs from all those already described—is the fact that the substances employed in the purification are only such as really augment greatly the agricultural value of the precipitated manure, and thus make it sufficiently valuable to bear the cost of transport to a distance.

The solid deposit from sewage, when considered as a manure, is admitted to be but of extremely little value; so that if, as in the A B C and other processes, a large amount of clay, or other equally worthless substance, is added, this small value per ton is diminished to an extent that the resulting manure becomes utterly worthless, except in the immediate vicinity of the works. On the other hand, by the new process, what is added are compounds rich in phosphoric acid, in a state of combination available for immediate assimilation by the plants themselves.

The natural phosphate of alumina, which we specially recommend, is a product which at present has no commercial value, and occurs in the West Indian Islands in such enormous quantities that, on one island alone, the report of the survey estimates the deposit at no less than 9,000,000 tons. Many other natural phosphatic deposits, found both in this country and elsewhere, are also capable of furnishing an abundant supply of material well suited for carrying out this process at but a very small expense.

In conclusion, I may state that the object in bringing forward this communication is to direct attention to a process which, we believe, may prove an extremely valuable one in such localities as are found unsuitable for sewage irrigation, for some of the reasons before stated.

ON THE SO-CALLED "ALKALINITY OF CARBONATE OF LIME."

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

My attention has been drawn to a paper by Mr. Skey, in which he states that carbonate of calcium, either artificially prepared, or in the form of limestone or calc-spar, possessed well-marked and rather decided alkalinity.* I have been experimenting lately with lime and its compounds, and as that statement was so contrary to my observations, I think it well to point out wherein, in my opinion, lies Mr. Skey's error (a very natural one). Such statements frequently creep into manuals and other works on chemistry without being submitted to sufficient proof, and become accepted as facts.

It will be observed on reading Mr. Skey's communication that he simply relies on reddened litmus paper as a proof of the alkalinity. Now, if we examine the condition of red litmus paper, we see at once that the tinctural matter is simply loosely combined with the acid used to redden it, and that the carbonate of calcium acts by abstracting the acid, and thus the litmus is brought back to its normal colour—a blue with a shade of violet.

If Mr. Skey will repeat the following experiment, I think he will be persuaded of the neutrality of carbonate of calcium.

A little water was re-distilled from a few grains of bisulphite of potassium, the object being to get a perfectly neutral water, almost all distilled water being faintly alkaline. Red litmus paper was made by moistening litmus paper with very dilute acetic acid, washing, and drying. Blue litmus paper was purified by washing with pure water, by which it generally becomes a little more violet, the blue of ordinary litmus being due to a slight alkalinity; turmeric paper was also washed. The three papers, as thus prepared, were then placed into a test-tube with the above water, and a few grains of pure precipitated carbonate of calcium, which I had by me from a previous experiment, was added. The red litmus speedily became of its normal shade, from the abstraction of the acetic acid to form the acetate of calcium, but, on standing twenty-four hours, the other two papers did not show the slightest sign of alkalinity; even blue litmus, under such a circumstance, would become a most delicate test, as it becomes distinctly bluer to an experienced eye, and such was not the case.

The experiment was repeated, but in this case a rhomb of Iceland spar was coarsely crushed and used as the carbonate; exactly similar results were obtained, except that the change in the red litmus was slower and evidently took place only where the particles of spar were in actual contact. The blueing of the litmus paper proceeded in blotches; there was no change with the blue litmus or the turmeric papers.

Carbonate of calcium is quite neutral, and it is evident that reddened litmus paper is not reliable as a test in such a case as the above.

Laboratory, Apothecaries' Hall of Ireland.
September, 1870.

ON THE PRECIPITATION OF CÆSIUM AND RUBIDIUM SALTS WITH THE INSOLUBLE SALTS OF LIME.

By J. LAWRENCE SMITH.

Having seen E. Sonstadt's statement in the July number of the Chemical News, and having worked a great deal with the salts referred to in connection with lime, I never observed the reactions alluded to in Sonstadt's paper. If true, they would effect very materially the

* Chemical News, vol. xxii., p. 85.

results of certain analyses in which I am now engaged; some special investigations were, however, made, to test the accuracy of his statements. 500 m.g. of pure carbonate of lime were dissolved in hydrochloric acid with 20 grammes of water; to this 150 m.g. of chloride of cæsium were added; the lime was now precipitated by carbonate of soda, the precipitate thrown on a filter and washed with the usual precautions adopted in all my analyses; the carbonate dried and weighed gave 499 m.g. of carbonate of lime.

The same experiment was made substituting carbonate of ammonia for the carbonate of soda, and the resulting carbonate of lime was 498 m.g.; the filtrate was evaporated to dryness and ignited gently, to drive off sal-ammoniac; the residue was 151 m.g., having used 150 m.g. of chloride cæsium. An experiment was also made using oxalate of ammonia; the resulting carbonate was with ½ m.g. of the carbonate of lime originally used. Still another experiment was made, identical with the first, and the resulting carbonate of lime was within ½ m.g. of the original quantity.

Experiments were made with lime and the rubidium salts, with similar results; so that Sonstadt must be mistaken in the precipitation of rubidium and cæsium salts, when lime is thrown down in the form of carbonate from solutions containing both lime and rubidium and cæsium salts, or I must have made my experiments under very different conditions from those made by him.

Louisville, Ky., August 11th, 1870.

[Professor Smith will find, on reference to our issue of July 22, that Mr. Sonstadt has anticipated the corrections which he (Professor Smith) makes.—*Ed. C. N.*]

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor TYNDALL, LL.D., F.R.S.

(Concluded from p. 115.)

Influence of Time on Intensity of Discharge. The Condenser.

315. The intensity of the secondary current—its "discharging distance," for example—depends upon the rapidity with which the primary is interrupted.

316. I have already referred to the passage of particles between the two severed terminals of a circuit. By these particles the current may be kept up for a short time after the terminals have been disunited. A *gradual* dying away of the primary is the consequence.

317. But to produce the maximum secondary intensity it is necessary that the primary should be extinguished *at once*.

318. This is very effectually accomplished if the primary be broken between the poles of a strong magnet. The secondary spark may be thus made to overleap distances, vast in comparison with those possible to it when the rupture of contact occurs far away from the magnetic poles.

319. The magnet quenches immediately the stream of particles which accompany the spark. Thus, instead of being spread over a very sensible interval, the whole power of the primary is concentrated into an instant of time.

320. This concentration is announced by the loudness of the report of the primary spark. This augmentation of loudness was first observed by Page; it was explained by Rijke, who also exalted in the way here indicated the discharge of the secondary coil.

321. The injurious effect of the spark produced by the rupture of contact in Ruhmkorff's coil is much diminished by the employment of a condenser, which is attached to the primary. It was introduced by Fizeau.

Electric Discharge through Rarefied Gases and Vapours.

322. The electricity from the prime conductor of an electrical machine passes through the air in the form of a dense and brilliant spark, which produces a very audible report.

323. When the discharges passes through rarefied air the discharging distance is augmented, and by sufficiently rarefying the air the discharge may be caused to pass *silently*. It then fills the tube through which it passes with a rosy light.

324. This rosy light has the same origin as that of the Aurora Borealis: it is due to the nitrogen of the air.

325. Every attenuated gas has its own characteristic colour when traversed by the electric discharge. When examined by a prism, the colour resolves itself into distinct bands; the nature of the gas may indeed be inferred from the analysis of its spectrum.

326. The discharge of the induction coil through attenuated media produces luminous effects similar to those produced by the electric machine.

327. The tubes containing the attenuated gases or vapours are usually called *vacuum tubes*. Through the tubes pass platinum wires which are fused into the glass, and between which the discharge passes.

328. Such tubes are produced in great perfection by Geissler, of Bonn, and are sometimes called Geissler's tubes.

329. Under certain circumstances, the luminous discharge is composed of distinct luminous strata, separated from each other by dark intervals transverse to the direction of the discharge. These strata were first observed by Grove; they were first observed independently and finely developed by Ruhmkorff.

330. The luminous strata were believed to arise from the intermittent action of the contact-breaker of the induction coil; but Gassiot produced them both with the electric machine, and with his battery of 3500 cells, where no contact-breaker is employed.

331. Every single discharge of the induction coil through a properly chosen medium resolves itself into a series of pulses, which declare themselves as a stratified discharge. Under similar circumstances the discharge from the voltaic battery also is resolved into a series of pulses which are declared by their stratifications.

Action of Magnets on the Luminous Discharge.

332. The luminous discharge is, to all intents and purposes, an electric current, and is acted on by a magnet like a wire carrying a current.

333. But the flexibility of the luminous current in rarefied gases enables the magnet to act upon it in a manner peculiarly interesting and instructive.

334. Placing, for example, a tube through which the luminous discharge is passing between the poles of an electro-magnet, by exciting the magnet the stream of light may be either deflected or wholly extinguished.

335. In the latter case, by interrupting the current passing round the magnet, or by lifting the tube out of the magnetic field, the luminous discharge is restored.

336. In certain cases, when the luminous discharge consists simply of a feeble glow, the supervention of the magnetic force draws a series of strongly illuminated strata from the positive terminal of the vacuum tube; when the magnetism is interrupted, these strata retreat again in succession, as if swallowed up by the positive pole. A number of exceedingly beautiful experiments of this character has been made by Gassiot.

337. It has been stated in Note 306 that the discharges from the induction coil proceed always in the same direction; hence in each vacuum tube we have a positive terminal or pole, and a negative terminal or pole.

338. When the light surrounding the negative terminal

is subjected to a magnet, it ranges itself exactly along the lines of magnetic force; the light at the positive terminal shows no such action. This discovery is due to Plücker.

Magneto-electric Machines. Saxton's Machine. Siemens's Armature.

339. Faraday's discovery of magneto-electricity was announced in 1831. In 1833 a machine was constructed by Saxton for the more copious development of magneto-electric currents.

340. In it copper-wire coils, within which were placed cores of iron, were caused to rotate before the poles of a powerful magnet.

341. On the approach of a coil to one of the poles of the magnet, a powerful current, whose direction depended on the nature of the pole, was induced in the coil. When the coil retreated from the magnetic pole, a current in the opposite direction was induced. This production of opposite currents by approach and withdrawal has been already referred to in Notes 283, 284.

342. By means of an instrument called *a commutator*, which reversed one of the induced currents at the proper moment, the opposite currents were caused to flow in the same direction.

343. The cores of soft iron and their associated coils constitute what is called an *armature*. In Saxton's armature the coils were wound *transversely* to the iron cores.

344. But, by winding his coils *longitudinally*, or parallel to the axis of the core, and placing the armature so formed between the poles of a series of horse-shoe magnets, Siemens obtained magneto-electric currents much more powerful than those of Saxton.

Wilde's Machine.

Things were in this state when, in 1866, Wilde made an important addition to our knowledge of magneto-electricity.

345. He conducted the current obtained by means of Siemens's armature round an electro-magnet, and found that the magnetism thus excited was far greater than that of the entire series of steel magnets employed to generate the magneto-electric current.

346. Thus, in one case, he found that, whereas the series of permanent magnets taken collectively was competent to support a weight of 40 lbs. only, the electro-magnet which they excited sustained a weight of 1088 lbs.

347. To produce this effect, however, it was necessary that the armature of the magneto-electric machine should rotate with great rapidity.

348. But Wilde went farther. Forming his electro-magnet from a large plate of iron, and placing between its long poles a correspondingly long armature, similar in shape and construction to that of the magneto-electric machine, he obtained from this second armature currents of enormously greater power than those obtainable from the first.

349. These currents could, in their turn, be sent round a second electro-magnet, formed from a larger plate of iron. Furnished with a rotating armature, this second electro-magnet produced effects previously unknown. Rods of iron a quarter of an inch in thickness were fused by the currents, and they were also found competent, when discharged between carbon terminals, to produce a light of intolerable brilliancy.

Siemens's and Wheatstone's Machine.

350. The next great step in magneto-electricity was made simultaneously by Dr. Werner Siemens and Sir Charles Wheatstone.

351. Expressed generally, this discovery consists in exalting, by means of its own action, to a high pitch of intensity an infinitesimal amount of magnetism.

352. Conceive an electro-magnetic core with a very small amount of residual magnetism, which is never wholly absent when iron has been once magnetised. Let a secondary coil, with cores of soft iron, rotate before the poles of such a magnet. Exceedingly feeble induced currents will circulate in the secondary coil. Let these induced currents, instead of being carried away, be sent round the electro-magnet which produced them; its magnetism will be thereby exalted. It is then in a condition to produce still stronger currents. These also being sent round the magnet, raise its magnetism still higher, a more copious production of induced currents being the consequence. Thus, by a series of interactions between the electro-magnet and the secondary helix, each in turn exalting the other, the electro-magnet is raised from a state of almost perfect neutrality to one of intense magnetisation.

353. When the magnet has been raised to this condition, other coils than those employed to magnetise it may be caused to rotate before, or between, its poles; the currents from these coils may be carried away and made use of for magnetisation, for chemical decomposition, or for the electric light.

354. The first magneto-electric machine used to produce a light sufficiently intense for lighthouses was constructed by Mr. Holmes. In it permanent steel magnets and rotating helices were employed. Mr. Holmes has lately constructed a very powerful machine on the principle of Siemens and Wheatstone.

Induced Currents of the Leyden Battery.

355. If a Leyden jar, or battery, be discharged through a primary spiral, it evokes a current in a secondary spiral. With a strong charge this secondary current may be caused to deflagrate a foot of thin platinum wire.

356. If the current from the secondary spiral be led round a third spiral which faces a fourth, on discharging the battery through the primary spiral, the secondary in the third spiral acts the part of a primary, and evokes in the fourth spiral a *tertiary current*.

357. With another pair of spirals this tertiary current can be made to generate a current of the *fourth order*; this, again, with another pair of spirals, a current of the *fifth order*. All these currents can impart shocks, ignite gunpowder, or deflagrate wires.

For the investigation of the induced currents of the Leyden battery we are indebted to Professor Joseph Henry, Director of the Smithsonian Institution, and to Professor Riess, of Berlin.

NOTICES OF BOOKS.

Researches on Diamagnetism and Magne-Crystallic Action, including the Question of Diamagnetic Polarity. By JOHN TYNDALL, LL.D., F.R.S., &c., Professor of Natural Philosophy in the Royal Institution of Great Britain. London: Longmans, Green, and Co., 1870.

THE work before us is a first instalment of the collected publication of the author's original memoirs on experimental physics, communicated by him to the *Philosophical Transactions* and the *Philosophical Magazine*, during the last 18 years. These researches were begun at Marburg at the close of 1849, and have been since continued at Berlin, and completed in England. In the introduction to this series of memoirs, the author relates the discovery of, and first researches on, diamagnetism, by the celebrated Faraday. The first 184 pages are devoted to eight memoirs by the author, and the remainder of the volume contains letters, essays, and reviews relating to magnetism and electricity; the work as it is gives to the reader a very complete and excellent account of all facts and theories relating to this portion of natural philosophy. It is copiously illustrated with plates and woodcuts, and is, in every sense of the word, a most interesting as well as useful publication.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science), at the Liverpool Meeting, under the presidency of Dr. Roscoe, F.R.S. They will be published, in full or in abstract, according to their importance, in the CHEMICAL NEWS.

The President's Address.

Report of the Committee on the Chemical Nature of Cast-Iron.—Communicated by D. Forbes, F.R.S.

Henry Deacon, J.P.—*A New Chlorine Process without Manganese* (with illustrations).

Walter Weldon.—*On the Weldon Process for the Manufacture of Chlorine* (with illustrations).

A. E. Fletcher, F.C.S.—*Air Pollution from Chemical Works.*

J. Berger Spence, F.C.S.—*On the Phenomena of the Crystallisation of a Double Salt.*

W. H. Perkin, F.R.S.—*On Artificial Alizarine* (with illustrations).

W. Gossage, J.P.—*On the Lancashire Alkali Trade.*

T. Fairley, F.C.S.—*On the Hydrogenation and Hydriodate of Cyanogen.*

T. Fairley, F.C.S.—*On the Distillation of Sulphuric Acid.*

Dr. Hurter.—*On the Time Needed for the Completion of Chemical Change.*

J. H. Gladstone, F.R.S.—*On Reciprocal Decomposition Viewed with Reference to Time.*

A. Vernon Harcourt, F.R.S.—*On a Method for the Determination of Sulphur in Coal Gas.*

W. Marriott, F.C.S.—*On the Estimation of Sulphur in Coal Gas.*

J. Dewar, F.R.S.E.—*Note on Thermal Equivalents*—1. *Fermentation.* 2. *Oxides of Chlorine.*

J. Spiller, F.C.S.—*On the Discrimination of Fibres in Mixed Fabrics.*

Report of the Committee on the Treatment and Utilisation of Sewage.

David Forbes, F.R.S.—*On the Utilisation of Sewage, with Special Reference to the Phosphate Process.*

James Hargraves.—*On the Separation from Iron Furnace Cinder of Phosphoric Acid for Manurial Purposes.*

E. C. C. Stanford, F.C.S.—*On the Retention of Nitrogen by Charcoal.*

Dr. Gerland.—*On the Action of Sulphurous Acid in Aqueous Solution on Phosphates and other Compounds.*

A. E. Fletcher, F.C.S.—*On the Purification of Sankey Brook.*

R. C. Tichborne, F.C.S.—*Dust as a Ferment.*

E. Schunck, F.R.S.—*On the Chemical Composition of Cotton.*

C. Tomlinson, F.R.S.—*On the Action of Low Temperatures on Supersaturated Saline Solutions.*

C. Tomlinson, F.R.S.—*On a Salt Invisible in its Mother Liquor.*

Peter Spence, F.C.S.—*On an Attempt to Determine the Boiling-Point of the Saturated Solution of Various Salts by Boiling with Steam of 100° C.*

J. Birkbeck Nevins, M.D.—*On a New Theory respecting the Heating of Liquids.*

Professor A. W. Williamson, F.R.S.—*Communication respecting a Resolution of the Committee of Section B on the Proposed Establishment of a New School of Applied Science by Government.*

Professor Roscoe, F.R.S.—*On Vanadium* (illustrated by preparations of its compounds).

Dr. B. W. Gerland.—*Note on the Occurrence of Vanadium.*

J. Arthur Phillips, F.C.S.—*Note on Claudet's Process for the Extraction of Silver.*

W. H. Walenn, F.C.S.—*On the Electrolytic Deposition of Copper and Brass.*

J. Fenwick Allen, F.C.S.—*On the Alloys of Copper, Tin, Zinc, and Lead with Manganese.*

A. M'Gordon.—*How to Prevent Lead-Poisoning in Water.*

Dr. Moffat.—*On Atmospheric Ozone.*

E. C. C. Stanford, F.C.S.—*On the Marbles of Tyree.*

A. H. Church, M.A.—*Experiments on the Preservation of Stone.*

Rev. H. Highton.—*On Artificial Stone and Certain Forms of Silica.*

W. J. Cooper.—*On the Use of Solutions of Soluble Chlorides for Laying Dust in Thoroughfares.*

W. C. Roberts, F.C.S.—*Note on the Absorption of Hydrogen by Electro-Deposited Iron.*

Dr. Moffat.—*On the Excretion of Phosphoric Acid in Connection with Atmospheric Conditions.*

A. H. Church, M.A.—*Contributions to Mineralogical Chemistry.*

Place of Meeting for Next Year.—It has been decided to hold the next meeting of this Association at Edinburgh, under the presidency of Sir William Thomson, F.R.S., &c. The meeting in 1872 will be held at Brighton.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1870.

This number contains the following original papers and memoirs:—

New Methods of Water Analysis.—A. Müller.—The author of this paper proposes the concentration of water by means of partial evaporation *in vacuo*, the residue to be dialysed, and the colloidal substance to be submitted to putrefactive fermentation. The mineral residue formed by the method of concentration of the water just alluded to is also to be dialysed by the aid of the addition of some hydrochloric acid. The estimation of the various constituents of water is described as follows:—The water to be analysed is evaporated to dryness, after the addition of an excess of any alkaline carbonate; the dry residue is digested with hot water, and the solution filtered; the insoluble matters collected on the filter, consisting of the earthy substances contained in the water, and also the silica and phosphoric acid. The filtrate is first very accurately neutralised with either nitric, sulphuric, or hydrochloric acids, and evaporated to dryness, and next dried at from 115° to 120°, until no more loss by weighing is observed. The dry residue is, after having been weighed, first ignited by itself, and again after the addition of bichromate of potassa.

Homologues of Isethionic Acid.—E. Schwarz.—This lengthy memoir is divided into the following sections:—Experiments in the methyl, amyl, butyl series; sulphuric anhydride.

Rufigallic Acid.—B. Jaffé.—The author refers to the researches of Robiquet, Löwe, Malin, and others on this subject. The chief point of interest in this paper is the fact that rufigallic acid, when distilled with pulverised zinc, yields a hydrocarbon which, in every one of its reactions, exhibited properties akin to those of pure anthracen; while the author also observed that rufigallic acid is very similar, though not identical, with alizarine, in this respect, that it (rufigallic acid) dyes cotton; previously mordanted with aluminous and ferric mordants, fast, but by no means bright or brilliant colours. The formula of rufigallic acid is $C_{14}H_8O_8$, containing 4O more than alizarine. A great portion of this paper is devoted to a lengthy review of the constitution of rufigallic acid and its relation to anthracen; but this portion of the paper is illustrated by a series of lengthy and complex formulæ, which space forbids us to reproduce here. The preparation of alizarine from rufigallic acid by means of reducing agents is considered by the author as possible, but he has not yet succeeded in this direction.

Elementary Analysis.—L. Carius.—The author first refers to his former communications on this subject, published some years ago in other periodicals, and next explains that his process of analysis is chiefly intended for the rapid estimation of other elements than C, H, N, and O, present in organic compounds. His plan of action consists in an oxidation of the organic bodies enclosed in sealed tubes, heated to various but high temperatures, the glass tubes being enclosed in iron tubes. The oxidising agent chiefly employed is pure nitric acid; and the author states that this body can be heated by itself, without very much dissociation, to about 250°. It is clear, however, that, for the purpose herein alluded to,

the glass tubes should be strong, and their dimensions comparatively narrow, since, even with such small quantities as only 2·1 to 4·2 grms. of nitric acid, in tubes of from 45 to 50 c.c., the internal pressure may range from 22·3 to 44·6 atmospheres (each atmosphere = 15 lbs. to the square inch). The author states that, even if the temperature were raised to from 320° to 350°, no explosion took place. The paper, illustrated with a woodcut, gives a lengthy description of the mode of operation; and some instances are quoted to prove the value and ready action of this method. Charcoal disappears entirely at 250°; graphite requires from 300° to 330° for complete oxidation in two hours. The quantity of organic matter to be operated upon may be small, 1 grm. of material answering the purpose completely.

Vapour Density of Acetic Acid.—A. Naumann.—The author draws the undermentioned conclusions from some 70 vapour density estimations, made at varying temperatures and pressure:—(1) When the temperature remains constantly the same, the quantities of acetic acid contained in the unit of volume increase in greater ratio than does the pressure. (2) The density of the vapour of acetic acid, compared with that of air, under the same conditions of pressure and temperature, decreases with an increase of temperature, even though the quantity of vapour remains the same. Hence it follows that (3) the vapour of acetic acid, at different temperatures, cannot be composed of mutually-similar molecules; but equal quantities of acetic acid form, at lower temperatures, a smaller number of molecules. (4) Presumably, when an average distance between the molecules has been reached, the attraction of the molecules decreases.

On Benzo-Kreatine.—P. Griess.—This paper is chiefly a collection of lengthy and complex formulæ. Benzo-kreatine is the name given by the author to a new base, derived from amido-benzoic acid cyanide. The formula of benzo-kreatine is $C_8H_9N_3O_4$. Benzo-kreatine stands in the same relation to amido-benzoic acid as kreatine does to sarkosine.

Researches on the Ether-Derivatives of Poly-Atomic Alcohols and Acids.—L. Henry.—This very lengthy memoir is divided into the following sections:—Action of pentachloride and pentabromide of phosphorus upon some ethers; glycolic acid ether and lactic acid ether (the latter is the paralactic acid ether, as stated in a foot-note); malic acid and uvic acid diethyl ether.

Preparation of Naphtœ Acid on the Large Scale.—V. Merz and H. Mühlhäuser.—This paper is identical with that quoted by us from No. 13 of the *Zeitschrift für Chemie von Beilstein.*

On Curcumine.—J. Kachler.—The author's researches on this subject were begun before those of MM. Daube and Gajewsky (see CHEMICAL NEWS, vol. xxii., p. 84) on this subject were published. As regards the contents of this paper, we learn, in the first place, that an aqueous decoction of the previously-ground root is a yellow-coloured turbid liquid, which can only be obtained free from vegetable matter insoluble in water by being passed through a silk sieve. The decoction contains, in addition to the ordinary vegetable substances, a large quantity of acid oxalate of potassa. The residue of the root, having been dried, was first treated with sulphide of carbon, yielding to it about 8 per cent of dark red coloured, fixed, fatty, very difficultly-saponifiable oil, which, when treated with sodium amalgam is decolourised so far as to become straw-yellow coloured; it consists of 79·8 per cent of carbon and 9·6 per cent of hydrogen, the remainder being oxygen. After having been treated with sulphide of carbon, and dried, the residual matter of the turmeric was exhausted with concentrated alcohol, yielding to it a dark brown-red coloured resin, which was found to be partly soluble in ether, and constituting what has been named curcumine. The author purified this resinous body, by dissolving it in dilute ammonia, precipitating that solution with chloride of calcium, collecting on a filter what was thrown down, and obtaining, by adding to the yellow-coloured filtrate, some hydrochloric acid, a yellow flocculent substance, which, after having been thoroughly well washed, was dried *in vacuo* over sulphuric acid, and constituted a chrome-yellow coloured powder, which, on elementary analysis, yielded, in 100 parts—Carbon, 69·90; hydrogen, 5·70. The author's opinion is that this body may be simply chrysophanic acid; and he tested this experimentally by distilling a small portion with pulverised zinc, obtaining thereby, as far as the tests executed upon a small quantity admitted of ascertaining it, a body identical with anthracen. Raw curcumine, as first obtained by exhaustion of the turmeric with alcohol as above mentioned, was dissolved in warm and very dilute caustic potassa; the deep red-brown coloured solution was boiled with sodium amalgam, and thus decolourised to a light yellow colouration. Access of air being sedulously avoided, the alkaline fluid was precipitated with an acid yielding a buff-coloured, flocculent, resinous precipitate, *a*; the filtrate containing a substance, *b*, which was extracted from the liquid with ether. *a* is evidently a resin readily soluble in alcohol, but difficultly in ether, benzol, and sulphide of carbon; after having been dissolved in alcohol, and precipitated again with water, and dried, it was found, on elementary analysis, to contain, in 100 parts—Carbon, 73·77; hydrogen, 7·76. On being oxidised with fusing caustic potassa, it yields protocatechusic acid. As regards *b*, it was left, after evaporation of the ether, as a syrupy body, consisting chiefly of a weak acid which combined well with bases; but the author's researches in this direction are not complete, for want of sufficient material, and are to be resumed.

Researches on the Specific Heat of the Aqueous Solutions of Chemical Compounds.—J. Thomsen.—This very lengthy memoir contains chiefly the following series of tabulated forms and results of experiments:—Specific heat of sulphuric, nitric, hydrochloric, and tartaric acids at 18°; molecular caloric of solutions of sulphuric, nitric, hydrochloric, and tartaric acids; specific heat of the alkalies—viz., hydrates of potassium and sodium, and hydrate of ammonium, at 18°; molecular caloric of aqueous solutions of caustic potassa, soda, and ammonium-hydrate.

Cyan-Benzidine.—E. Wittenstein.—Benzidine, prepared from azobenzol, was dissolved in alcohol, and into this solution cyanogen gas was passed until supersaturated with that gas. This alcoholic solution, after having been left standing for some time, deposited a red-coloured amorphous body, insoluble in water, only sparingly soluble in alcohol, ether, and benzol, but somewhat better soluble in light petroleum oil. [This is a very ill-defined expression for a solvent, since light petroleum oil, also known as ligroine, is certainly not always of the same composition, and may, therefore, in some instances, turn out not to act as a solvent.] The elementary analysis of the cyan-benzidine led to the formula $C_{14}H_{14}N_4 = C_{12}H_{12}N_2{}^2CN$.

Dimorphism of Tin.—C. Rammelsberg.—The author refers, at great length, to some experiments made with tin by Dr. Fritzsche and other *savants*, and next states that he concludes, as to the dimorphism of tin, as a result of researches which prove that the sp. gr. of tin obtained by electrolysis, and also that of the metal after exposure to great cold, is far less (viz., from 7·143 to 7·195) than after the metal has been molten, when its specific gravity varies from 7·29 to 7·31. Its form (viz., crystalline) after fusion is, as far as can be ascertained, regular; but, at a very low temperature, this form is entirely modified, and belongs to the irregular system.

Naumann's Doctrine of the Caloric of Atoms, and on Horstmann's Criticism thereanent.—E. Budde.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xv. (Nos. 1 and 2), May and June, 1870.

These numbers contain the following original papers relating to chemistry and collateral sciences:—

Action of Light upon the Tissues of some Mono- and Di-Cotyledonous Plants.—A. Batalin.—This lengthy essay, illustrated by several woodcuts, contains an account of experiments made with the view to ascertain the effect of the action of direct and diffused sunlight on the development of the different parenchyma plants are histologically composed of.

Determination of the Weight of a Cubic Decimetre of Water at 4° C.—H. Wild.—This memoir contains the results of a series of experiments made with the view to ascertain what precision is attainable in practice as regards the determination of the absolute weight of the cubic decimetre of distilled water at 4°; this value the author finds to be within 1 milligrm. The paper also contains some observations, deduced from the author's researches, in reference to the labours of the International Committee for Decimal Weights and Measures, and the making of standard types of the same.

Lignite Found near Sméla, District of Kijew, and the same Mineral occurring near Jelisawetgrad, District of Cherson (Russia).—G. von Helmersen.—A lengthy geological paper, chiefly of local interest only.

Complete Arrangement for Compensating for Temperature with the Weighing or Balance Barometer.—H. Wild.—Illustrated with diagrams.

New Researches concerning the Remains of Mammalia found in the Altaic Cavern, a Contribution to the Quaternary Fauna of the Russian Empire.—F. Brandt.

The Sponges of the White Sea and Arctic Ocean.—N. M. von Maclay.

Chondrodite Crystals from Finland.—N. von Kokscharow.

Crystals of Greenockite.—N. von Kokscharow.—Two crystallographical essays.

Deviation of Plumb-Line caused by the Attraction of the Caucasian Mountains.—J. Stebnitzki.

Bayerisches Industrie und Gewerbe Blatt, June, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Earthen- and Crockery-Ware which is Injurious to Health.—L. Buchner, E. Erlenmeyer, and C. Stölzel.—This lengthy paper is a report made by the authors to the Bavarian Minister of Commerce and Public Works, concerning the means by which, in the manufacture of earthen- and crockery-ware, the use of enamels containing lead as a flux may be either entirely avoided, or rendered innocuous, by the use of a very limited and small quantity of oxide of lead in combination with other substances, so as to prevent the glaze being acted upon by weak acids, such as, for instance, vinegar.

Occurrence, Preparation, and Technical Application of Glycerine.—C. Scheuer.—This very lengthy monograph contains all that is known relating to this subject, but does not mention any new researches made by the author, who has taken great care to produce an excellent and exhaustive compilation.

Black Dyeing of Horn without the Application of Boiling Heat.—C. Burnitz.—The objects made of horn, and ready for use, but not yet polished, are placed in a lye of caustic soda or potassa, and left therein until a portion of the surface has been dissolved, which may be readily detected by the somewhat fatty feeling the horn assumes when touched with the fingers.. The objects are next washed in pure fresh water, and afterwards passed through Lucas's aniline black. After having been dried, the objects are washed, and, lastly, polished.

Washing and Exhaustion of Precipitates and other Substances.—Dr. Bolley.—The author applies, instead of hot and boiling liquids (water, alcohol, ether, benzol, sulphide of carbon, acetic acid),

the vapours of these fluids, in the following manner:—On the funnel containing the substance and filter to be washed or exhausted is placed another funnel of the same size (it is best that both funnels should have ground edges, but this is not indispensable), fixed by means of a sufficiently wide vulcanised india-rubber band. Through the neck of the upper funnel, steam, or the vapour of any of the above-named liquids, is made to pass, by connecting, with suitable tubing, the neck of the said funnel with a flask containing the fluid, which is kept boiling. The author states that, although steam, for instance, and the other vapours exert some pressure upon the filter, it rarely breaks; and his experience is, that, for washing precipitates (oxide of iron, for instance), hot steam works far more efficiently than hot water; while, for the purposes of exhausting substances, say, with alcohol, ether, &c., the vapours of these fluids act far more rapidly, effectively, and economically than the liquids at their boiling-point do by themselves.

Les Mondes, September 1, 1870.

Curious Facts relating to Holtz's Electrical Machine.—Dr. Morren.—The author, in a brief note addressed to the reverend editor of the above-mentioned periodical, states that he has obtained what he calls several electrograms (although not precisely specified, these appear to be a kind of photogram, but produced, not by the action of light, but by that of electricity). These electrograms exhibit—The manner electricity is distributed and seen on a positive, as well as negative point, also on a sphere of varying diameter; the electric movements which can exist in a hollow sphere electrised with positive and negative electricity; the manner electricity is distributed on different parts of the machine while in action, while giving off long, short, or middle-sized sparks, and also with or without condensers.

Iron and Hydrogen.—Dr. Klein.—The author, a pupil and collaborator of Professor Jacobi, of St. Petersburg, states, that the iron obtained by electrolysis is not, as has been often thought, the pure metal, but, on the contrary, a compound or mixture of iron and hydrogen, which, when heated to redness, gives off an enormous amount of that gas, and becomes, while greatly increasing in bulk, a silver-white, very soft, ductile, and malleable metal, which decomposes water readily below its boiling-point and oxidises most rapidly.

Curious Circuit of Lightning at Valenciennes.—Rev. F. Moigno.—At about 6 p.m. on the 27th of July last, lightning struck, and splintered to match-wood, the mast of a vessel lying in the canal; thence the lightning wended its way to an iron foundry, and, after traversing it for its full length, escaped along the iron stove-pipe placed in the office of the foundry; thence it proceeded up the steeple of St. Géry, entering there, through a broken glass-pane, the room inhabited by the tower watchman. In that room, it (the lightning) fell upon a galvanic battery, employed to convey, by means of electricity, the movements of the clockwork to the townhall clock, situated at several hundred metres' distance, causing such havoc and disturbance through the connecting wires that it was supposed the lightning had fallen on that building. Leaving the steeple of St. Géry, the lightning first fell on the house of an artist, and, after having broken some panes of glass therein, turned to the clock-tower of the college, melting, without any breakage, several panes of glass, and turning other panes of glass into a mass of curiously-coloured non-transparent substance; and, lastly, issuing again near the canal, slightly struck a soldier on duty there, and disappeared in the water. It is clear that, without special knowledge of the topography of the town above-named, it is not well possible to imagine this curious circuit, which, however, represents a broken line, having a basis of an arc of about 45°, and a total length of about 700 metres.

Polytechnisches Journal von Dingler, first number for August, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

The Electric Clock.—Dr. Arzberger.—With engravings.

Gold, Platinum, and Silver, as Applicable to the Ornamentation of Porcelain, Glass, and other Substances.—Dr. H. Schwarz.—This paper treats, at great length, on the commercial preparations of the metals alluded to, as manufactured for the purposes of being applied to china, porcelain, &c. The paper is too lengthy for any useful abstraction.

Observations on Dr. Bischof's Paper concerning the Fire-Resisting Properties of Clays.—Dr. Richters.

Action of Nitric Acid upon Toluidine.—M. Ballo.—This paper contains the results of some theoretical discussions elucidated by a lengthy series of formulæ, with the view to prove that it may be possible to obtain, by the action of nitric acid upon toluidine, a nitro-kresol; but, practically, the author found that this was not attainable.

Testing Beer for the Presence of the Bitters of Quassia, Wormwood, and Marsh-Trefoil.—L. Enders.—The beer to be tested is first evaporated on a water-bath to the consistency of a syrup; to this is added strong alcohol, whereby the dextrine is precipitated; the liquid is filtered, and the filtrate again evaporated, to extract consistency. This extract is again dissolved in strong alcohol, and mixed with ether, for the purpose of removing glucose. The liquid having been filtered, the ether is evaporated, and the residue taken up with weaker alcohol and precipitated with acetate of lead. (*a.*) The precipitate containing the lupuline and hop-resin is filtered off, washed with water, and, after having been suspended in some distilled water, is decomposed by sulphuretted hydrogen. The sulphide of lead is collected on a filter and washed with alcohol; the joint liquids are again evaporated to dryness, and the residue treated with chloroform. Water is added to this solution, and the chloroform is driven off by evaporation, whereby hop-resin is separated. The aqueous solution, from which the hop-resin has been separated by filtration, yields, on evaporation, in case it contains lupuline (as with genuine beer it ought), a bitter-tasting acid residue, soluble in alcohol, ether, and chloroform, the weak alcoholic solution of which is precipitable by acetate of lead, not so by tannin, and not yielding, with an ammoniacal silver solution, a metallic mirror. (*b.*) The liquor which ran off from the lead precipitate is first treated with sulphuretted hydrogen, to remove excess of lead; the liquid, having been filtered, is gently heated, to expel excess of sulphuretted hydrogen gas. There is next added to the liquid an aqueous solution of tannic acid; the ensuing precipitate will contain (if they were present) the three other above-named bitters. This precipitate is next, while yet moist, mixed with carbonate of lead (white-lead, the original says), dried, exhausted with boiling alcohol, filtered, the filtrate evaporated to dryness, and the residue extracted with pure ether. (*a.*) The ethereal solution is evaporated to dryness. When the dry residue is mixed with concentrated sulphuric acid, it exhibits, on careful addition of water, a bluish violet colouration, yielding, when boiled with ammoniacal silver solution, a metallic mirror (absinthiïne). (*β.*) The substance which remains insoluble in ether, but is soluble in alcohol, and precipitable by tannin, but not by acetate of lead, is menyanthin (from *Menyanthes trifoliata*, marsh-trefoil), when it yields, on being warmed with ammoniacal silver solution, a metallic silver mirror; but, if this last reaction fails, quassiïne is present.

Annales de Chimie et de Physique, July, 1870.

This number contains the following original memoirs and papers:—

Expansion of Gases.—A. Cazin.—The continuation and concluding portion of this lengthy essay. This portion contains the following sections:—Description of a series of experiments; experiments with air; experiment with carbonic acid; observations on the expansion from 9 to 1 atmospheres; modifications of the apparatus, and description of the mode of experimenting; degree of correctness of the method; influence of the dimensions of the reservoirs; lowering of the temperature in the preceding experiments; experiments wherein p_1 varies and p_2 remains constant; conclusion.

Composition of Skin, the Modifications it Undergoes by Tanning, and the Fermentation of Tannin in Tan-Pits.—A. Muntz.—This paper is a somewhat enlarged reproduction of the author's memoir on this same subject, published in the *Comptes Rendus* of December 20th, 1869, and quoted in the CHEMICAL NEWS, vol. xx., p. 321.

Researches on the Glyceric Combinations.—L. Henry.—This paper treats more especially on glyceric tribromhydrine; and the author reviews the results of the labours of a great many scientific chemists on this substance, and finally concludes by stating that he has obtained a tribromhydrine, $C_3H_5Br_3$, a neutral liquid of an ethereal and not unpleasant odour; colourless; sp. gr. at 10°, 2·407; insoluble in water boiling at about 220°; and identical in properties with tribromide of allyl.

Study on the Molecular Action Founded on the Theory of Capillary Action.—C. A. Valson.—This very lengthy memoir is divided into the following chapters:—Introduction; on the curved lines known as "indicatrix lines"; method of experimenting; *resumé* of the experimental results; conclusions, and laws of modulus.

NOTES AND QUERIES.

Decomposition of Fulminate of Mercury.—Can any of your readers inform me of a safe process for the decomposition of fulminate of mercury? I wish to obtain the mercury in the metallic state.—C. H.

Assaying of Nickel.—Can any of your readers who are, or may have been, students at the School of Mines give me an outline of the assaying of nickel and cobalt ores, also arsenical ores, as practised at the said school?—A STUDENT IN METALLURGY.

Analysis of Old Yellow Metal.—(Reply to "Copper").—We have referred to a number of works on chemistry, but do not find anywhere quoted what you desire. Unless the information occurs in the *Revue Maritime et Coloniale* or in the *Annales des Mines*, we believe your only chance of obtaining the analysis you wish for is to have them executed for you. The works referred to may be inspected at the Library of the Commissioners of Patents.

TO CORRESPONDENTS.

Guy's Hospital.—In our paragraph respecting the successor to Dr. Taylor, we should have stated that Dr. Debus and Dr. Stevenson are appointed joint Lecturers on Chemistry.

Nemo.—There is no Examination. Fill up the certificate sent by post and forward it to the Secretary, Burlington House, Piccadilly, W.

E. K.—The *Revue des Cours Scientifiques de la France et de l'Etranger* is published at 17, Rue de l'École de Médecine. Messrs. Baillière could probably get it for you.

B. W. Gibsone.—Received.

Cook.—An advertisement would be the best way of acquiring the information.

Liverpool Royal Infirmary School of Medicine.—In our Students' Number, for J. C. Brown, B.Sc., read J. C. Brown. D.Sc.

TECHNICAL EDUCATION.

SCIENCE AND ART DEPARTMENT.

Royal College of Science for Ireland,
Stephen's Green, Dublin.

SESSION 1870-71.

This College supplies, as far as practicable, a complete Course of Instruction in Science applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

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The Course of Instruction is recognised by the Secretary of State for India as Qualifying for Appointments in the Engineering Department.

There are Four Royal Scholarships, of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year. They are given to Students who have been a year in the College. There are also Nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education and Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the Annual May Examinations of the Science and Art Department.

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SUBJECTS OF INSTRUCTION.

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THE CHEMICAL NEWS.

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ON A NEW METHOD OF OBTAINING CHLORINE.*

By HENRY DEACON, J.P.

IT is well known that when a mixture of hydrochloric acid gas and oxygen is sufficiently heated, portions of the hydrogen and oxygen combine and some chlorine is liberated, and the proportion of chlorine can be increased by passing the hot gases over hot porous substances. The quantity of chlorine, however, at the best is inconsiderable.

The method now under consideration induces these reactions at much lower temperatures, and so actively that the whole of the hydrochloric acid gas can be decomposed and its chlorine liberated, or pure nitrogen can be obtained from atmospheric air by combining all its oxygen with the hydrogen of hydrochloric acid.

It consists in the employment of some substance over which the hot mixed gases are passed, the substance remaining unchanged, yet influencing the changes in the gases.

Copper salts possess this power in a very marked degree, and of them sulphate of copper is so convenient that I have generally employed it. But all the compounds of copper hitherto tried have proved to be equally active; many, of course, become changed by oxidation, or are converted into chloride, the change is generally slow, whilst the activity is continuous.

Sulphate of copper, however, comes out of this experiment unchanged. All the corresponding compounds of lead, except one, are also active, but require a higher temperature. The exception is the sulphate of lead, which thus contrasts singularly with the corresponding copper compound. All the manganese compounds at still higher temperatures are also active, but it is doubtful if with manganese the reaction is ever complete. At the high temperature requisite with manganese it seems probable that chlorine itself reacts on the water produced to re-form hydrochloric acid and oxygen.

A large number of experiments have proved that all that is necessary is to dip pieces of common red brick into a saturated solution of sulphate of copper and dry them. With these charged pieces tubes are filled, and the heated gases (hydrochloric acid gas and oxygen) are passed through the tubes.

The temperature at which the reaction is most active is about 700°—750° F., but it is operative as low as about 400° F. If the temperature be raised to about 800° F., chloride of copper begins to volatilise. That is to say that, although no chloride of copper be originally employed, it is, under the circumstances, always formed and volatilised when the temperature reaches about 800° F.

The exact temperature is defined with some considerable eservation, as the difficulties of observation are very great. It is, however, believed to be correct within moderate limits, and, as might, perhaps, have been expected, the reaction depends quite as much, and with some probability more, upon the temperature of the mixed gases than upon the temperature of the influencing agent. In this way an indefinitely small particle of sulphate of copper, remaining itself at the end of the process unchanged and unmoved, can effect the liberation of the whole of the chlorine from an indefinitely large mass of hydrochloric acid gas.

In the first long-continued experiment one equivalent of copper gave upwards of 300 equivalents of chlorine, and was as active at the end as at the commencement.

It has been found that increasing the loading of sulphate of copper above a certain point on the pieces of brick does not increase their efficiency. To prove this, pieces of brick were carefully sorted as to size and used alone, and the minute amount of chlorine evolved from a heated mixture of the gases was noted.

Pieces of the same size were then boiled down with a given volume of a solution of sulphate of copper, dried and used in the same apparatus, under the same conditions, and the result noted. They were then charged with a second additional quantity of sulphate of copper, and the experiment repeated, and finally crystals of sulphate of copper itself, of the same size as the pieces of brick, were dried and used, and the result in grains of chlorine in the same time was the same in each of the experiments with copper.

In the experiments with the brick only, the quantity obtainable in the laboratory has not exceeded three per cent, whilst with copper, as before described, the whole of the chlorine has been set free. Further experiments have also shown that, at the same temperature, the same surface of copper compounds (and it is believed all other compounds follow the rule) gives the same quantity of chlorine in the same time, provided, of course, that sufficient heated oxygen and hydrochloric acid gas are presented to it. The truth of this law with copper compounds has been proved within very wide limits. The speed of the current of gases and the composition of the mixture of gases have been widely varied. The speed can be reduced until the chlorine evolved is the whole the hydrochloric acid gas contains, or increased till the chlorine evolved forms but a small percentage of the mass passing, yet the total weight of chlorine evolved from the same apparatus at the same temperature in the same time is constant. Of course if the gases were mixed with others exerting a chemical influence, the results would be varied, but with such gases as vapour of water, nitrogen, carbonic acid, and sulphuric acid gases, there is no change in the law. In point of fact, the atmosphere has been the source of oxygen almost always employed, therefore nitrogen has been constantly present, and vapour of water is one of the substances formed by the reaction, and must, therefore, always be present. Whilst the weight of chlorine remains constant, the percentage of work done will necessarily vary with the quantity of hydrochloric acid gas passed. If the current be so slow that the reaction is complete, then 100 per cent hydrochloric acid gas will be decomposed; but if double the quantity of acid gas be passed in the same time, only one-half of it will be decomposed, or only 50 per cent of its chlorine will be liberated, and similarly for other quantities.

For laboratory experiments we have used an ordinary glass combustion-tube. A little trough is made out of sheet-iron, a few iron borings are sprinkled at the bottom and the tube laid in them; heat is applied to the trough by a row of Bunsen's burners. The metal of the trough and the borings spreads the heat and secures a tolerably uniform temperature. The little pieces of brick employed with the tube are about the size of small peppercorns or large mustard seeds. A constant current of hydrochloric acid gas is obtained by using a lump of sal-ammoniac and strong vitriol in a bell hydrogen apparatus; the pressure of the gas evolved displaces the acid used, and prevents waste of material, and delivers the gas under pressure. The current of air has been obtained from the action of the Sprengel water-pump that does our laboratory filtering.

For ordinary experiments, the mixture of the gases can be regulated by dipping the two gas-delivery tubes into aqueous hydrochloric acid, and by counting the bubbles of gas from each tube. If the tubes are of equal diameter, and the same configuration, and immersed the same depth, a sufficiently accurate estimate can be formed of the proportions of the mixture. With a combustion-tube, not quite 2 feet long and about ½-inch bore, the reaction will be so complete, that the resulting gases, collected in a

* Read before the British Association, Liverpool Meeting, Section B.

2-ounce flask of white glass, exhibit very strongly the characteristic colour of chlorine. Of course the chlorine can be detected and estimated by the ordinary chemical reagents, when it is in far too small quantities to give an apparent colour in so small a mass. With due care, this experiment can be continued until the chlorine obtained is many hundred times equivalent to the copper employed; not a trace of copper will be volatilised, and, when the patience is exhausted or examination is desired, the sulphate of copper will be found intact and free from chloride of copper, fit, apparently, to continue active for an indefinitely long time. If, however, the experiment be watched through the tube from the commencement, and a piece of iodised starched paper be used to detect the first passage of chlorine in the washed gases, a change of colour will be detected in the heated sulphate of copper, simultaneously with the detection of the first chlorine. This tinge resembles the colour of heated chloride of copper, and remains constant during the experiment, but disappears as the tube cools. The known property of heated sulphate of copper to absorb hydrochloric acid gas appears, therefore, to be closely connected with this phenomenon. For more accurate experiments glass gasometers, containing the mixed gases in known proportions, and working with vitriol saturated with hydrochloric acid gas, were employed, and the current and time were, by these means, carefully regulated. The temperature, in the small scale, was ascertained, within certain limits, by the melting of enclosed morsels of metals and alloys of known composition.

I trust now to be excused for giving the reasons which led me to anticipate this reaction; for it is not a so-called accidental discovery, but, as regards chloride of copper and chloride of manganese, it was deduced from what I think a logical argument on known facts. I hope, also, to be excused in saying that, in making and applying this deduction, I was not aware that the idea of a general law of chemical action, under which this reaction appears to fall, had been originated by Mercer in 1842, before the meeting of the British Association in Manchester, and further elaborated by Playfair, in a paper read before the Chemical Society, and published in their *Transactions*, vol. iii. (1847); and, so far as I know, the subject, as regards a general law of action, still remains much as Playfair left it.

It is scarcely necessary to say the effect of any general law would be to remove a variety of chemical actions from the indefinite limbo of "contact action" or "catalysis."

Before going further, I will use Playfair's words to describe his own views and those of Berzelius, Liebig, and Mercer.

As typical of the class of reactions, Mercer's experiment may be taken. On dissolving 1 oz. of oxalic acid in ½ a pint of water, at 180° F., and adding to this 1 oz. of colourless nitric acid of 1·30 sp. gr., no action ensues, but immediately commences on the addition of a proto-salt of manganese, as, for example, its oxalate or nitrate. These proto-salts of manganese influence a reaction, and are themselves unacted upon. Berzelius regarded this kind of power to be "a distinct electro-chemical agency different from other recognised powers," and he named it the "catalytic force."

Liebig viewed it as a dynamical action on the atoms of a complex molecule, conceiving that the activity of the atoms of a body in a state of motion may be communicated to those of another body in a state of rest.

Mercer's view was that catalytic bodies act by exerting a feeble chemical affinity on one of the constituents of the body decomposed.

Playfair says the catalytic body is, therefore, a substance which acts by adding its own affinity to that of another body, or by exerting an attraction sufficient to effect decomposition under certain circumstances, without being powerful enough to overcome new conditions, such as elasticity and cohesion, which occasionally intervene and alter the expected result.

Playfair's paper abounds with experimental illustrations, and is most suggestive.

The idea of the law which had occurred to me proves to be an extension of the much earlier idea of Playfair's.

With your permission I will explain it from my point of view, although, after the authorities quoted, I do so with much reserve.

It appears to me that the force we call chemical action is usually dealt with as if its operations were restricted to obtaining results strictly lying within the lines of direction of the forces applied. To illustrate this mechanically, a body may be supposed to be moved from a point in the north-east to another point in the south-west. Chemically, this would be said to be accomplished either by a force acting in that direction, or first by one force, which acted from east to west, carrying the body to the west, where, subsequently upon its arrival, it was acted upon by another force from north to south, carrying it to the same point to which it would have arrived had it moved from north-east to south-west direct. And where more forces than one are concerned in the movement of the body, the forces are supposed to unite in the same direction or line, by simple addition. In mechanics, the path of motion would be held to be the resultant either of two or more forces acting in the direction of motion, or of two or more forces acting in different directions, the difference of direction being no obstacle to the effect produced as the resultant.

My idea is that concurrent chemical forces unite, and are resolved into other equivalent forces, similarly with mechanical forces. A chemical result, therefore, may either be the resultant of direct forces, or the resultant of many indirect forces acting in many directions; and, also, the resultant of indirect forces may bring about a chemical result, which lies outside the path or direction of many, and, in some cases, perhaps, outside the path of all, the forces engaged. That is to say, we may deal with the composition and decomposition of concurrent chemical forces much in the same way that we deal with these problems in mechanics.

Two familiar chemical operations formed with me the basis of this idea, namely, the manufacture of sulphuric ether by the continuous process, and the manufacture of sulphuric acid. In the first of the two, a mass of vitriol is heated, and on it is poured a small stream of alcohol, or vapour of alcohol is passed over hot vitriol. The result is the decomposition of the alcohol into ether and water, the vitriol remaining unchanged. The ordinary explanation (I believe Liebig's) is, that this depends on the union of the acid and alcohol as sulphovinic acid, and the subsequent decomposition of this acid by heat into ether and water. But, at the temperature employed, sulphovinic acid cannot exist; how then can it be formed? Again, as to sulphuric acid making. The crystalline compounds formed by the union of some of the gases, and the chamber sickness, as it is called, are almost too familiar to dwell upon. Suffice it to say that, by a series of successive reactions, which, probably, most of us have seen beautifully illustrated on the lecture-table, it is said that sulphuric acid is formed. But, in the manufacture itself, what becomes of these compounds?

They are no sooner perceived, in however minute degree, than the manufacturer of either ether or of sulphuric acid hastens to destroy them, and if any of them ever are detected in practice the process is known to be out of order.

Sulphovinic acid is a reality—these chamber compounds are realities, but they are never seen in the successful process of manufacture. Although these compounds are unseen, the forces which would form them are there. Those forces are active too, for combination is the result of action, as motion is the result of force. A moving body and a chemical combination may each be sources of force, but there is a necessary distinction to be regarded between the exertion of force and the results which ensue when that force has been exerted. I have said these compounds

are unseen, and this word should be understood in its widest sense. No contrivance can detect their presence. What more is needed to prove their absence? The conclusion I draw is, they are not there, but the forces which would make them are there, and it is to the union or composition of those concurrent forces that the reaction is due as a direct result. That is to say, using my first mechanical illustration, the path followed by the bodies operated upon, is not that from east to west, which would first make these compounds, and then by the path from north to south in order to decompose them, and so yield at the south-west the product of materials which started from the north-east, but the path followed is direct from north-west to south-east. It is the direct and not indirect resultant of the concurrent forces engaged. Engaged, but not satisfied, for the same vitriol would react on indefinitely large masses of alcohol, and the same nitrous acid would cause the formation of indefinitely large quantities of vitriol.

Having conceived this idea of the action of chemical forces, I wished to prove it. But it seems to admit of only one form of positive proof, namely, that of time. I will continue the use of the illustration already adopted, viz., two forces acting in the same plane at right angles to each other, one north to south, the other east to west, and the object starting from the north-east and delivered in the south-west. If the path of the object as governed by the forces be first from east to west and then north to south, the time occupied in the entire journey will be the times of the two separate journeys added together. But, if it passes from the conjoint influence of the two forces diagonally, and direct from north-east to south-west, the time occupied will only be the time it would occupy to perform one of the journeys. So far I have been quite unable to adopt this proof. The first conditions are wanting. It cannot, I think, yet be said in what directions the forces lie. They may also be of different kinds, attractive and dispersive. The lines of force, although brought together by some medium, may, so to say, lay in different planes, and some may oppose and some assist. There is a further difficulty when bodies are considered to be in motion under the influence of forces of constantly varying intensity. The forces of attraction and repulsion vary probably in proportion to the square of the distances, and chemical force may follow the same law. The actual path of a body amidst a number of centres of force must, therefore, be curved, for with every change of position the relative intensity of the forces acting upon it must vary. This kind of proof seems, therefore, to be at present unattainable.

The next kind of proof—that of accounting for all known phenomena of the kind called catalytic—presupposes a knowledge of all the forces engaged in each reaction, and this knowledge I certainly do not possess. The remaining available proof was to apply the theory to known cases to foretell a hitherto unknown result.

This opportunity occurred when considering a proposition to obtain chlorine from chloride of copper by first heating it, whereby half its chlorine is set free, then oxidising it in a moist atmosphere, adding hydrochloric acid to it, and again heating it, when chlorine is again evolved, and the copper compound is left for another oxidation; and thus by constantly repeated, but distinct and consecutive, operations, the same mass of copper could be used for the production of large quantities of chlorine. The same principal material, chloride of copper, was also proposed as a source of oxygen. After it has lost half its chlorine and is oxidised, as just described, it yields oxygen on heating. Here, then, was the opportunity: hydrochloric acid and oxygen are each separately attracted and held at the same temperature, by the same body; and yet if both are previously united with the body, they are let go, but are divided into chlorine and water.

I argued that the forces concerned were acting, so to say, in the same plane; they were concurrent, and should therefore unite, and the resultant should be a direct and not an indirect reaction; the wind and the current should carry the ship diagonally but directly, not first blow her across the stream, and then afterwards float her down it to her port. This was put to the test at my request and instigation by Dr. F. Hurter, the able head of our laboratory. The first experiment that was made in a hasty extemporised way yielded 10 equivalents of chlorine from one of copper employed. For convenience, I had suggested the use of oxide of copper, not chloride, and it was mixed with peroxide of manganese, partly to prevent fusion of the chloride of copper which we expected would form, and partly because I felt persuaded that chloride of manganese would react in the same way. This expectation was also subsequently proved to be correct, but it occurs, as was anticipated, at a much higher temperature. The conversion of these oxides into chlorides was so slow that at first we thought they were unchanged. The manganese was first acted upon and then the copper, but the oxidation of the hydrogen of the hydrochloric acid was the same first and last. A regular series of experiments were then decided upon, and all were performed by Dr. Hurter in our laboratory, and to this gentleman belongs much of the credit of the success attending the experiments hitherto made. I claim the discovery and the reasoning that led up to it, as before explained, but all subsequent progress has been the result of constant conference between Dr. Hurter, Mr. Eustace Carey, the manager of the works, and myself, and I am glad to have this opportunity of acknowledging the value of their assistance.

Although the discovery was made about three years ago, it has not yet been applied successfully as a commercial undertaking to the manufacture of bleaching-powder. The delay has arisen in great part from a long and serious illness which befell me, and partly from having previously engaged to put into operation at our works another and a very successful process, Mr. Weldon's, which was at first much nearer the bird in the hand than my own.

We are now vigorously working upon the subject on the large scale, and are more and more impressed with the value of the discovery, and believe the end of our difficulties is near at hand.

One of our first difficulties was to measure the speeds of the gases. Mr. A. E. Fletcher has shown how this can be done with the use of an anemometer of his contrivance, but we found many difficulties in its use in a rough way. His table of speeds for pressure, and other information of that kind, have, however, proved invaluable. Mainly by Dr. Hurter's assistance, a different form of anemometer was devised. An example lies on the table. It was described a few months ago before the Philosophical Society of Manchester by another gentleman as his original idea. We have no reason to doubt that the same idea has occurred to others as well as ourselves; we believe, however, our instruments were in use at a much earlier date. We can speak in high terms of its value; and perhaps some members may be glad to learn of Holtzapffel's paper scales, each ruled separately by a dividing engine. Any arbitrary division can be had, so that very good verniers and scales for home-made instruments of many kinds may be obtained at small cost.

The next obstacle was a serious one, and has only been recently overcome: it was the difficulty of measuring the temperature of the gases; it being important to know it accurately and quickly, within small limits, and the range being too high for mercury. The quenching in water of masses of copper heated in the furnace, and measuring the heat gained by the water, as proposed by Siemens, is accurate, but too tedious to be of use as a constant watchman. All the ordinary pyrometers, consisting of a tube of brass outside an iron tube or rod, with some mechanical indicator of the difference of expansion between the two metals, were proved to be defective at temperatures above 500° F. The brass tube elongates both permanently and irregularly. Being deceptive, they were worse than useless.

We have recently employed rods of brass and iron instead of tubes, making the iron carry the brass, instead of, as usual, the reverse, and, up to temperatures not over 1000° F., with complete success; a very important difficulty is therefore removed by simple means. It is not easy to say why the apparently trifling change is so effective. We think the errors in ordinary pyrometers of this class arise, in part, from a permanent change in the diameter of the brass tube, which takes place with every material change of temperature, and partly from a stretching of the tube when it is softened by heat. The rod, being solid, is more uniformly heated through its diameter, and is better able to resist change of dimension in the direction of the diameter, so does not alter by mere heating and cooling. It is relieved from strain, and therefore does not stretch; and two similar-sized rods being compared together, the errors tend to correct each other.

An apprehended difficulty proved to be groundless. Nitrogen is, of course, largely mixed with the chlorine, and, it was supposed, in making bleaching-powder, might prevent the saturation of the lime with chlorine. But good bleaching-powder is easily made, even with very moderate decomposition, and consequent large dilution of chlorine, simply by employing large surfaces of lime in series, the strong gases passing over the nearly saturated lime, and the spent gases over fresh lime.

The undecomposed hydrochloric acid is removed by water, and this aqueous acid dissolves mere traces of chlorine, so that all the chlorine produced is available for operating with.

The reaction itself is a source of heat—4 volumes of hydrochloric acid and 1 volume of oxygen yielding 2 volumes of water and 2 of chlorine; that is, 5 volumes are reduced to 4 volumes. With the atmosphere as the source of oxygen, the nitrogen brings up the volumes to about 9 volumes reduced to 8. 10,679 units of heat are given out, using Favre and Silbermann's figures of 34.462 units, resulting from the union of oxygen and hydrogen, less 23,783 units required as the combining heat of hydrogen and chlorine. The water and nitrogen present absorb this heat and reduce the apparent temperature; but this evolution of heat is a material assistance in making up for the loss of heat in the decomposing apparatus from radiation.

Taking the hydrochloric acid gas as it is evolved by the ordinary salt-cake apparatus, it is found that air is normally present in sufficient quantities to liberate all the chlorine; and, as there is a wide margin for dilution in either direction, without any material evil, another anticipated difficulty disappears.

There is no occasion to be constantly watching the mixture of gases.

It has been found that iron resists, very completely, the action of the chlorine in the decomposing apparatus. A common iron gas tube is produced which has been exposed to the heated chlorine for about a fortnight, and others have been so exposed for months without any appreciable wear; iron, therefore, is freely employed, and possesses many evident advantages.

The heat of the gas requires to be carefully regulated; with too much heat, chloride of copper is sublimed; if the heat be too low, the reaction decreases, and at length stops. We use a regulator consisting of brickwork, carefully enveloped, to prevent radiation. It acts as a reservoir to absorb and yield surplus heat; and we can easily maintain a current of gases for twenty-four hours within a variation of 25° F., and without skilled attendance.

The real difficulties, as far as we know, are three. First, the large bulk of gases; these need a large apparatus. A manufacturer making 40 tons daily of sulphate of soda would have to deal with about 1,100,000 cubic feet of these gases daily; he already deals with that bulk. It is not proposed to increase the quantity evolved in the process; the difference will be in the way of treating it. In preparing the vitriol for the manufacture of his 40 tons of sulphate of soda, he has dealt with at least 3,400,000 cubic feet of gases in vitriol chambers.

Chemical manufacturers are therefore trained to deal with gases in magnitude, and we apprehend little difficulty on this account.

Secondly, there is the preliminary heating of the gases, and this is a question mainly of durability of apparatus; it is the only part in which at present there is much wear and tear. Brick- or tile-flues, heated exteriorly, are objectionable because of the numerous joints and leakage. It is proposed to adopt Cowper's method of heating hot-blast for iron furnaces—viz., to heat a mass of brickwork, then cut off the fire to heat another mass, and pass the gases through the heated mass; by the time that it is cooled, the second mass will be heated, when the current of gas will be reversed, and so on.

We think well of this plan, but are at present trying cast-iron pipes, and, with large surfaces, moderately heated, have every prospect of success.

The last difficulty known to us arises from the volatilisation of some iron with the hydrochloric acid, and we have not yet thoroughly examined these substances. Of course they are assumed to be, and probably are, chlorides of iron, but there are peculiarities about their appearance needing investigation. The peculiarity is mainly this: they are not deposited until they reach the copper-salts.

Until very recently, we thought it was merely a condensation in a cooler part of the apparatus; but this is not the case. The difficulty itself is, that the passages become gradually filled up, and the first part of the apparatus has to be cleaned out. We find, when the copper-salts are warm enough, the sublimate we take to be chloride of iron disappears, and is replaced by sesquioxide of iron, an obturant equally objectionable. We think it is now proved that this deposition, in the first instance, is a formation depending upon the presence of chlorine; it occurs only where free chlorine is present, and is soon deposited. The sesquioxide of iron no doubt results from the decomposition of this substance in the presence of oxygen, chlorine, and moisture, at a higher temperature. The remedy we have adopted, and are now engaged in proving, is, to have the reactive filling arranged with vertical openings over an empty space (we use agricultural drain-pipes one on another). The deposit is always pulverulent, and does not interfere with the reaction of the copper-salts. These vertical channels allow the heavy dust to descend into the space below, whence it can be withdrawn, and also afford easy access for clearing from the top.

The employment of leaden, instead of iron pans, for the decomposition of the salt, and the adoption of Cowper's plan of heating the gases, would prevent the introduction of iron to a very great extent. This combination forms part of our army of reserve, for use in case of need.

The gases are propelled by the aid of a chimney-draft, and we shall probably always prefer to draw, rather than to force them. The colour of the resulting gases gives a good indication of the success of the decomposition; and the proportion of hydrochloric acid in the air is easily ascertained, when desired, by a finger-pump, drawing known quantities at each stroke through a normal alkaline solution coloured with litmus. The greater number of strokes required before the blue colour is changed to red, the more air and less acid gas is present, and *vice versâ*.

In conclusion, I would give expression to some of the concurrent forces resulting in the reading of this paper.

First, we believe this process will soon materially affect the commercial industry of chlorine, and we desire to direct the attention of our fellow manufacturers to it; and, lastly, believing this little-worked mine of composition and decomposition of chemical forces offers rich prizes to skilled investigators, I desire to revive its consideration. May it not be said the skilled chemist, like the skilled navigator, can so use the union of forces, that, by aid of the wind

itself, he sails nearly in the wind's eye? And, to carry the metaphor one stage further, may it not be hoped, perhaps anticipated, that, by the application of new combinations of forces, a chemical "steam power" will make future chemists masters at will over chemical winds and tides?

REPORT OF THE COMMITTEE ON THE CHEMICAL NATURE OF CAST-IRON.*

WE regret to have to report that it has not been in our power, during the past year, to make any important progress in the investigation of the chemical nature of cast-iron, which was entrusted to us.

In the appendix to the report which we submitted last year, a process was described by which pure iron could be prepared in considerable quantities, and it was intended to apply this process at once to the preparation of the material necessary for our investigations. The apparatus and arrangements required for this purpose have, however, been unavoidably in a dismantled condition during the greater part of the year, in consequence of the reconstruction of the laboratories of St. Bartholomew's Hospital. They are now again in working order, and it is hoped that the experiments will be resumed without much further delay.

Numerous experiments have been made with a view to ascertain whether the pure iron sponge, prepared by the process above referred to, can be converted, by welding, into thoroughly solid masses, without detriment to the purity of the metal. Hitherto, the results obtained, though instructive in connection with the physical properties of the pure metal, have not been of promising nature in the particular direction desired. It is contemplated, however, to continue these experiments, with the aid of facilities which, we believe, will be available for this purpose, at the Royal Arsenal, Woolwich.

For the foregoing reasons, we beg leave to suggest that the re-appointment of this committee be recommended, but we do not consider it necessary to apply for a grant of money on this occasion.

F. A. ABEL, DAVID FORBES, A. MATTHIESSEN.

September 1st, 1870.

ON THE LANCASHIRE ALKALI TRADE.†

By W. GOSSAGE.

AT the meeting of the British Association for the Advancement of Science, held in Manchester in September, 1861, I had the honour to read a paper, entitled "A History of the Soda Manufacture," before the Chemical Section of that body. I now propose to submit a brief supplement to that paper, in which I will notice the various improvements connected with the processes of manufacturing soda, as then existing, during the lapse of nine years since that period; also some details of the increase which has taken place in the extent of this important manufacture during that time.

As one of the most important facts connected with the soda manufacture, I must not omit to notice the passing of a legislative measure, entitled "The Alkali Act, 1863," rendering it imperative that all manufacturers decomposing common salt, for the production of sulphate of soda, should condense not less than 95 per cent of the hydrochloric acid gas evolved by such decomposition. In my former paper I described fully the means which I had devised and carried into successful operation in the year 1836 for effecting such condensation, and these means are now adopted universally by the soda manufacturers, and so successfully that not only do they comply with the legislative requirements of condensing 95 per cent of the hydrochloric acid set free, but in many instances this condensation exceeds 99 per cent. It has been very fortunate for the manufacturers as well as for the public that Dr. R. Angus Smith was selected by the Government to undertake the duties of chief inspector under the Alkali Act of 1863. This gentleman, with his able staff of district inspectors, has assisted greatly in promoting the effective working of the system of condensation. The able reports submitted annually to the two houses of Parliament by Dr. Smith contain the fullest details of the working of this legislative enactment, and it may be fairly expected that when the same amount of care and attention has been applied to subduing the bad effects resulting from other noxious vapours, chemical manufactories will be relieved from the charge of occasioning injury to their vicinities.

The most important use for hydrochloric acid obtained by such condensation is the manufacture of hypochlorite of lime, or bleaching-powder, the demand for which has taken an extraordinary development since the introduction of straw, esparto grass, and some other substances than rags for the manufacture of paper.

At the date of my last paper, the chlorine required for the manufacture of bleaching-powder was obtained by the action of hydrochloric acid on native peroxide of manganese. Recently Mr. Walter Weldon, of London, after long-continued devotion of time, labour, and money, has succeeded in perfecting a process by which peroxide of manganese is obtained from the chloride of manganese, produced by the action of hydrochloric acid on peroxide of manganese. Mr. Weldon effects this object by causing the chloride of manganese to be decomposed by hydrate of lime, thus producing hydrated protoxide of manganese, which he converts into peroxide of manganese, by causing streams of atmospheric air to be forced through the fluid mixture of protoxide and water. When in this state of minute division the protoxide of manganese absorbs oxygen from the atmospheric air and becomes converted into peroxide. Mr. Weldon has found it essential for successful working, that not only a sufficient proportion of lime be used to precipitate the oxide of manganese, but that such an excess be employed as will be sufficient to form a chemical compound with the peroxide of manganese as thus is produced, which compound Mr. Weldon designates as manganite of calcium. This process has been successfully carried into practice in this district, also in that of Newcastle, and it has already been adopted by some of the largest manufacturers of bleaching-powder in both these localities.

It is well known that to obtain one equivalent of chlorine by the reaction of hydrochloric acid on peroxide of manganese, it is essential that two equivalents of hydrochloric acid should be employed, one of these yielding chlorine, the other chloride of manganese.

We have had the advantage of hearing from Mr. Deacon a full explanation of his very scientific process for the manufacture of chlorine without the use of manganese, by which process the whole of the hydrochloric acid is decomposed into chlorine. By this process each equivalent of hydrochloric acid yields an equivalent of chlorine.

Mr. James Hargreaves, of Widnes, has also devised means for producing chlorine without the use of oxide of manganese. He has a process for the separation of phosphorus from the iron slag produced in the puddling operation of the iron manufacture. In carrying out this process the iron slag is treated with hydrochloric acid, and thereby protochloride of iron in solution is obtained as a bye-product, which is evaporated to dryness, producing dry protochloride, and this, by slow application of heat with access of atmospheric air, becomes perchloride, which undergoes decomposition, yielding chlorine and peroxide of iron. This process also yields an equivalent of chlorine for each equivalent of hydrochloric acid employed.

In my former paper on the soda manufacture, I took

* Presented to the Secretary of Section B., British Association, Liverpool.

† Read before the British Association, Liverpool Meeting, Section B.

occasion to remark that nearly all the sulphur used in this manufacture (the cost of which is about equal to two-fifths of the total cost of materials required) was re-obtained in combination with calcium, forming what is expressively designated as "alkali waste."

I noticed, also, that this presented a problem worthy the attention of my juniors for its solution. Dr. Ludwig Mond, a German chemist, has made the nearest approximation to the solution of this problem with which I am at present acquainted. Mr. Mond's process consists, in the first instance, in causing atmospheric air to be brought into intimate contact with the alkali waste, as this is left in the lixiviating vats after treatment with water. This is effected by the use of a ventilating fan, which forces air into the lower part of the vat, under a false bottom. The air percolates the mass of waste, and a portion of its oxygen becomes absorbed by the sulphide of calcium yielding soluble hyposulphite of calcium, and at the same time a portion of the sulphide of calcium becomes converted into soluble polysulphide of calcium. The oxidisation is so regulated, as regards its extent, that the resulting solution, when this is obtained and treated with hydrochloric acid, should yield sulphide of hydrogen and sulphurous acid in such proportions as to mutually decompose each other, yielding free sulphur at the same time that the second equivalent of sulphur contained in the hyposulphurous acid of the hyposulphite of lime is set free. A very pure sulphur, almost absolutely free from arsenic, is obtained by this mode of working.

This process has been carried out successfully by various manufacturers, but, unfortunately, the quantity of sulphur obtained is far short of that contained in the waste, and I consider the problem I have mentioned still remains as an exercise for ingenuity and perseverance.

In my former paper on the soda manufacture, I gave some particulars of the means I had adopted for obtaining copper and silver from the burned residua of copper pyrites which had been used for yielding sulphur to manufacture sulphuric acid. This mode of working has been superseded by a process devised and carried out by Mr. Henderson. This process consists in mixing a small proportion of salt with burned pyrites, previously ground to a fine powder, and exposing this mixture to a low red heat, either in open reverberatory or closed furnaces, through which a current of atmospheric air is allowed to pass. By these means the small portion of sulphur which has escaped being consumed in the burned pyrites becomes oxidised, producing sulphate of iron, which decomposes common salt, yielding chloride of copper and sulphate of soda, which are obtained in solution on lixiviating the product with water. The copper is then precipitated from the solution by means of iron, and is obtained in the metallic state. A large quantity of oxide of iron is obtained as a residuum from the lixiviation. This is sold to the iron smelters for the production of iron. These operations are carried out very extensively by the Tharsis Metal Company, at Glasgow, Newcastle, and Widnes. There are also several other establishments engaged in the same business in the neighbourhood of Widnes—amongst others that of the Widnes Metal Company, where Mr. J. A. Phillips has carried out successfully a process invented by Mr. Santler, of London, for extracting gold, silver, and lead from the burned residua of copper pyrites.

In the year 1861, during the negotiation of the French treaty of commerce, it was estimated that the total quantity of salt decomposed in Great Britain for the production of soda was 260,000 tons per annum. Of this quantity, 125,000 tons were decomposed in what is called the Newcastle district, and 135,000 tons in the Lancashire district. According to the returns of the Alkali Manufacturers' Association, for the year 1869, the total quantity of salt decomposed for the manufacture of soda was 326,000 tons, thus showing an increase of 66,000 tons, or 25 per cent on the total. Of this quantity, the decomposition in the Newcastle district, in 1869, was 142,000 tons, which, being compared with 125,000 tons in 1861, shows an increase of 17,000 tons, or 13·6 per cent. The decomposition in the Lancashire district is returned as 184,000 tons in 1869, against 135,000 tons in 1861, showing an increase of 49,000 tons or 36 per cent. It would thus appear that the total quantity of salt decomposed for the manufacture of soda in the Lancashire district in 1869 exceeds by 30 per cent the total quantity decomposed in the Newcastle district during the same year.

One of the most important applications of soda to other manufactures is that of the production of soap, and it may be interesting to notice the increase in the production of this article, which is so essential to cleanliness, and, therefore, to civilisation. In the year 1852, when the excise duty on soap was finally abolished, the total production of soap in Great Britain was equal to 1600 tons per week, less than one-half of which was produced in the Lancashire district. From some inquiries which I have recently made I am satisfied that the present production of soap in the Lancashire district is fully equal to the total production in 1852. We may, therefore, infer that the production of this article has doubled during the past eighteen years.

I have shown from official documents that the production of soda in the Lancashire district exceeds by 30 per cent that of the Newcastle district, and when we remember the immense number of manufactories at work in Lancashire for the production of chemical substances to be used in bleaching, dyeing, calico printing, &c., we must adopt the conclusion that Lancashire is the largest seat of chemical manufactures in this country.

Dr. ROSCOE said that, by way of supplementing Mr. Gossage's remarks, he might say that, in the ten years previous to 1861, the increase in the amount of salt decomposed was 300 per cent—that is to say, in the year 1852 there were 38,600 tons, while in 1861 the quantity was 135,000.

ON THE BEHAVIOUR OF CASTOR OIL WITH PETROLEUM AND PARAFFIN OILS.

By HARRY NAPIER DRAPER, F.C.S.

THE liquids used in these experiments were:—

Petroleum oil	0·810 sp. gr.
Paraffin oil	0·817 ,, ,,
Petroleum spirit	0·710 ,, ,,

Each of these dissolves, at 16° C. in all proportions, the following fatty bodies:—

Almond oil.	Theobroma oil.
Olive oil.	Palm oil.
Rape oil.	Cod-liver oil.
Linseed oil.	Lard oil.
Sesame oil.	Cocoa-nut oil.
Croton oil.	Ergot oil.

And as these taken collectively typify a very large series of fatty oils, it may reasonably be supposed that there are but few exceptions to the rule of solubility. Castor oil, however, forms a very remarkable one. This oil which is on the one hand, separated from all others by its complete solubility in alcohol of sp. gr. 0·829, is, on the other, so insoluble in the petroleum hydrocarbons, that the addition of even one-half per cent to either paraffin oil or refined petroleum at 16° C. causes turbidity. At 50° C. a large quantity is taken up, but separates immediately as the liquid cools.

But though castor oil is itself insoluble in the petroleum oils, it exercises itself a solvent action upon them, which is remarkable for being limited in a very unusual manner.

If castor oil be shaken with excess of petroleum spirit at 16° C. and allowed to rest, it will be found to form two layers, the upper of which consists of petroleum spirit alone, and the lower of a mixture of petroleum spirit and castor oil in equal volumes.

The results of several experiments have shown that—

100 vols. of petroleum spirit dissolve 100 vols. of castor oil.
100 ,, ,, oil ,, 67 ,, ,,
100 ,, paraffin oil ,, 67 ,, ,,

If the hydrocarbons be agitated with castor oil in any larger proportions than these, the excess separates, but the increase in volume of the castor oil is always the same, so that castor oil does not affect the separation of any particular hydrocarbon.

There is no difference in the behaviour of East-India and Italian castor oils.

This reaction cannot, unfortunately, be used as a test for the presence of castor oil in other oils, because the presence of other fatty bodies in any quantity renders castor oil soluble in the petroleum oils. It will, however, distinguish this series of hydrocarbons from benzol, in which castor oil is soluble in all proportions.

Dublin, August, 1870.

EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.*

By FRANK H. STORER,
Professor in Massachusetts Institue of Technology.

(Continued from p. 109).

EXPERIMENT IV.—*Estimation of Water and Magnesia in Epsom Salt.*

To prepare a sample of crystallised salt proper for analysis, heat 40 or 50 grms. of commercial Epsom salt with as much boiling water as may be needed to dissolve it, filter the boiling liquid into an evaporating dish, and leave the latter at rest until its contents have become cold. A coating of crystals will then be found adhering to the bottom and sides of the dish. Pour off the liquor from above these crystals and fasten the dish in a vertical position, in such manner that most of the mother liquor may drain away and the crystals be left nearly dry. Press the moist crystals repeatedly between folds of thick filter paper until they become so dry that they no longer stick to the paper. Then weigh out about 4 grms. of the crystals for analysis.

To determine the water in the crystals proceed as in the analysis of gypsum (*Expt.* II.; CHEMICAL NEWS, vol. xxii., p. 99).

In our experiment 3·664 grms. of freshly crystallised Epsom salt lost 1·879 grms. of water on being heated. Or, in terms of per cent, 51·28. Theory requires 51·22 per cent.

To determine the magnesia, transfer the ignited salt from the crucible to a beaker of about 700 c.c. capacity, dissolve it in some 400 c.c. of cold water, stir into the solution 40 or 50 c.c. of a tolerably strong solution of chloride of ammonium together with enough ammonia water to make the liquid slightly alkaline. Finally, add a quantity of a solution of ordinary phosphate of soda, and stir the mixture thoroughly, taking care not to touch the sides of the beaker with the stirring rod. The precipitate of phosphate of magnesium and ammonium which falls is a crystalline substance liable to adhere firmly to any scratch, or even mark, which the stirring rod might leave upon the sides of the beaker in case it were allowed to rub against the glass. The liquid must not be heated at any time, lest the formation of the crystals be hindered.

As soon as it appears that a slight excess of the phosphate of sodium has been added, cover the beaker and leave it at rest for twelve hours or more, in order that the crystals of the double phosphate may all be deposited. Then pour the liquid and precipitate upon a six-inch filter, and wash the precipitate with a mixture of three parts water and one part strong ammonia water until a few drops of the filtrate show only a slight cloudiness on being mixed with a drop of nitric acid and a drop of nitrate of silver. Dry the precipitate, ignite it intensely in a porcelain crucible, and weigh the pyrophosphate of magnesium which remains.

There was obtained 1·672 grms. of $2MgO,P_2O_5$ (=0·6025 grms. MgO). This result indicates 16·44 per cent of magnesia in the Epsom salt. Theory requires 16·26 per cent.

The sulphuric acid could of course be determined by precipitating it with chloride of barium, as in Expt. II., or it may be estimated by the difference, as was done in the present case. The complete analysis was as follows:—

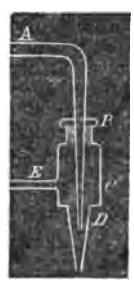
	Found.	Theory.
MgO	16·44	16·26
SO_3 (by difference)	32·28	32·52
$7H_2O$	51·28	51·22
	100·00	100·00

(To be continued).

ON A STEAM FILTER PUMP.*

By Dr. J. WALZ.

THERE are many locations in which the Bunsen filter pump cannot be employed on account of a deficiency in the water supply. For such cases a plan has been devised by Dr. Walz of New York, editor of the *Manufacturers' Review and Industrial Record*, which is described in that journal. and has been proved in practice to be efficient.



The accompanying cut shows the outline section of the most important part of the apparatus. A is a tube supplied with steam from a flask or boiler; E is connected with the exhaust of the filter. By the action of the steam jet identical with that known as the "exhaust" in a locomotive, a vacuum is produced in B, C, D. By sliding the tube, A, back and forward in the cork, B, an adjustment can be given to the outlet within D, so as to secure the best effect.

The conditions of best effect here are identical with those in the inner nozzle of the Giffard injector when it is starting its water supply from a lower level, and no doubt the proportions found most efficient in that instrument will prove also in this.

CHEMICAL TABLES ACCORDING TO THE THEORIES OF MODERN CHEMISTRY.†

By Professor ALBERT R. LEEDS.

(Continued from page 40.)

IN the *Comptes Rendus*, vol. xx., p. 1047, will be found another series of careful and laborious determinations of certain atomic weights by Pélouze. Other valuable contributions to our knowledge in this direction will be found in the *Bibliothèque Univ. de Genève*, vol. xlvi, by De Marignac, and by Erdmann and Marchand, in the *Journ. für Prakt. Chem.*, vols. xviii., xxvi., xxxi., and xxxiii. A brief synopsis of the processes and results which are given in the above-cited memoirs, is appended to Miller's "Elements of Chemistry," Part II., p. 859. For special contributions to our knowledge of the atomic weights of antimony, cadmium, and lithium, consult *Chem. Centr.*, 1857, pp. 454 and 897; *Wien. Acad. Ber.*, vol. xxv., 118; *Journ.*

* Communicated by the Author. From the *Massachusetts Teacher.*

* Communicated by the Author.

† Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute.*

für Prakt.Chem., vol. lxxii., p. 338; *Ann.Chem.Phys.* [3], vol. li., p. 103; *Silliman's Amer. Journ.* [2], vol. xxviii., p. 349; *Ann. Chem. Pharm.*, vol. cxxi., p. 93; *Comptes Rendus*, vol. liv., p. 366. Abstracts and references concerning the atomic weights of cæsium, rubidium, and thallium will be found in the *Jahresber. der Chem.* In a recent number of the *Journ. für Prakt. Chem.*, 1869, Rammelsberg has re-calculated the atomic weights of tantalum and niobium (columbium) after the analyses of Rose and De Marignac. In the *Am. Journ. Sci.* [2], vol. xlvi., p. 53, Dr. Genth has published the re-determination of the atomic weight of cerium, by Dr. C. Wolf, and his results are here accepted as representing at present the closest approximation to the truth. For the atomic weights of erbium and yttrium, consult the memoir, by Bahr and Bunsen, in the *Ann. Chem. Pharm.*, vol. cxxxvii., p. 1, and for terbium, that by Delafontaine, same journal, vol. cxxxiv., p. 99. Two series of independent analyses are given by Winkler, in the *Journ. für Prakt. Chem.*, vol. cii., p. 273, the mean of which makes the atomic weight of indium 37·81. To vanadium, Roscoe assigns an atomic weight of 51·33 (*Phil. Mag.* [4], vol. xxxv., p. 307.

De Marignac assigns to didymium the atomic weight 47·92 (*Ann. Chem. Phys.* [3], vol. xxxviii., p. 148; to lanthanum the concordant results of Mosander, Holzmann, and R. Hermann give 46·4 (*Journ. für Prakt. Chem.*, vol. lxxv., p. 321. and vol. lxxxii, p. 385). Our information concerning ruthenium is almost entirely derived from the labours of Claus (*Ann. Pharm.*, vol. lvi., p. 257, vol. lix., p. 234, and vol. lxiii., p. 259, which makes its atomic weight 52·1. From a careful perusal of the chemical testimony adduced in the foregoing memoirs, as to the true atomic weights, Table III. of the atomic weights, according to ancient chemistry, has been derived. Where the chemical testimony appeared equally strong for different values of the atomic weight of any element, the law of specific heats and isomorphism have afforded help in the decision. It is not expected that others would be impressed in precisely the same way by a similar examination of these data. But it is hoped that the table here given will commend itself as an accurate and impartial summary of our present knowledge, and that it may be taken with safety and advantage as a groundwork for the tables which follow. Appended to the atomic weight of each element is the authority upon which it rests. In every case, the result of the analyses themselves is given, and not the atomic weight deduced from them in accordance with Prout's law, or any other theoretical consideration. Neither has the mean of the atomic weights obtained by several observers for any element been taken, because we do not thus necessarily arrive at a truer approximation.

Upon Table III., as a foundation, Table IV. has been built up, in agreement with the hypotheses of modern chemistry. To mention what these hypotheses are, and in what manner they have been applied to the atomic weights of each element, would be vastly beyond the reach of our present purpose. They involve the labours of Kolbe, Kekulé, Hofmann, Frankland, Williamson, and a host of others who have projected and established the new chemical system.

In some cases, the atomic weights which are given as those of Berzelius, in the Table, according to ancient chemistry, are half of what he himself adopted. In regard to the atomic weights, the opinions of Berzelius, in many instances, were juster then those of the chemists who followed him—they retrograded.

TABLE I.

Atomic Weights according to the Original Observers.

ELEMENT.	BERZELIUS. O=100.	BERZELIUS. H=1.	OTHER OBSERVERS. O=100. H=1.
Aluminum	170·900	27·390	13·744, Dumas.
Antimony	806·452	129·240	120·3, Schneider; 120·69, Rose; 122·34, Dexter; 122, Dumas.
Arsenic	469·400	75·225	75, Pélouze; 74·95, Dumas.
Barium	855·290	137·070	68·51, Dumas; 68·64, Pélouze; 68·58, De Marignac.
Bismuth	1330·377	213·200	[1330·377, Lagerhjelm, adopted by Berzelius;] 210·34, Dumas.
Boron	136·204	21·830	[136·204, boracic acid being regarded by Berzelius as BO_3;] 11, Dumas.
Bromine	499·810	80·102	[499·81, De Marignac, adopted by Berzelius.]
Cadmium	696·767	111·660	[696·767, Stromeyer, adopted by Berzelius;] 56·12, Dumas; 56, C. v. Hauer.
Cæsium	—	—	133·00, Johnson and Allen.
Calcium	251·651	40·329	20·01, Dumas; 20·03, Erdmann and Marchand; 20·105, De Marignac.
Carbon	75·120	12·040	[75·005, Dumas;] 6·007, Erdmann and Marchand; 6·06, Liebig and Redtenbacher.
Chlorine	221·640	35·520	[221·64, De Marignac, adopted by Berzelius;] 35·505, Dumas; 35·476, Maumené; 35·46, Stas.
Chromium	328·380	52·630	[328·38, Berlin, adopted by Berzelius;] 26·24, Péligot.
Cobalt	368·650	59·080	[368·65, Rothoff, adopted by Berzelius;] 29·54, Dumas; 30, Schneider.
Columbium ..	—	—	98·45, Rose and De Marignac, re-calculated by Rammelsberg.
Copper	395·600	63·400	[396·6, Erdmann and Marchand.]
Didymium	—	—	47·92, De Marignac.
Erbium	—	—	56·3, Bahr and Bunsen.
Fluorine	117·717	18·865	19, Louyet; 19, Dumas.
Glucinum	87·124	13·960	[87·124, Awdejew, adopted by Berzelius.]
Gold	1229·165	196·990	— — —
Hydrogen	6·240	1·000	[12·5, Dumas; 12·5, Erdmann and Marchand.]
Indium	—	—	37·813, Winkler.
Iodine	792·996	127·080	[792·996, De Marignac, quoted by Berzelius;] 127, Dumas.
Iridium	1232·080	197·460	— — —
Iron	350·527	56·180	[350·59, Svanberg and Norlin; 350·1, Erdmann and Marchand;] 28·07, Dumas.
Lanthanum ..	—	—	46·4, Mosander, Holzman, and R. Hermann.
Lead	1294·645	207·460	103·5, Dumas; 103·456, Stas.
Lithium	81·660	13·087	6·97, Mallet.
Magnesium ..	158·140	24·760	12·11, Scheerer; 12·35, Svanberg and Nordenfeldt; 12·3, Dumas.
Manganese	344·684	55·240	27·48, Dumas.
Mercury	1251·290	200·530	[1251·29, Erdmann and Marchand, quoted by Berzelius; 1265·823, Sefström.]
Molybdenum ..	596·100	93·360	46·06, Svanberg and Struve; 48, Dumas.
Nickel	369·330	59·190	[369·33, Rothoff, adopted by Berzelius;] 29·51, Dumas; 29, Schneider.
Nitrogen	88·520	13·708	[88·52, De Marignac, adopted by Berzelius;] 14, Dumas; 14·041, Stas; 13·95, Anderson and Svanberg.
Osmium	1242·624	199·140	— — —
Oxygen	100·000	16·026	— — —
Palladium	665·477	106·650	— — —
Phosphorus ..	196·0205	31·414	32·02, Pelouze; 31·03, Dumas; 31, Schrötter.
Platinum	1232·080	197·000	98·94, Andrews.
Potassium	488·856	78·340	[488·856, De Marignac, adopted by Berzelius;] 38·95, Maumené; 39·14, Pélouze; 39·13, Stas.
Rhodium	651·962	104·480	— — —
Rubidium	—	—	85·4, Bunsen.
Ruthenium ..	—	—	52·1, Claus.
Selenium	495·285	79·374	— — —
Silicon	277·778	44·520	[Berzelius regarded silicic anhydride as SiO_3;] 14·24, Pélouze; 14·01, Dumas.
Silver	1349·660	216·290	107·97, Maumené; 107·945, Stas.
Sodium	289·729	46·430	22·97, Pélouze; 23·01, Dumas; 23·05, Stas.
Strontium	545·929	87·490	[545·929, Stromeyer, adopted by Berzelius;] 43·97, De Marignac; 43·84, Pélouze; 43·74, Dumas.
Sulphur	200·750	32·170	16, Dumas; 32·074, Stas.

ELEMENT.	BERZELIUS. O=100.	BERZELIUS. H=1.	OTHER OBSERVERS. O=100. H=1.
Tantalum	1148·365	184·040	182, Rose and De Marignac; re-calculated by Rammelsberg.
Tellurium	801·760	128·510	64·5, Dumas.
Terbium	—	—	37·68, Delafontaine.
Thallium	—	—	203, Crookes; 204, Lamy.
Thorium	743·860	119·210	— — —
Tin	735·294	117·840	58·05, Mulder; 59·03, Dumas.
Titanium	301·550	48·330	[301·55, H. Rose, adopted by Berzelius;] 25·17, Pierre.
Tungsten	1188·360	190·450	92, Dumas.
Uranium	742·875	119·060	[742·875, Ebelman, adopted by Berzelius.]
Vanadium	856·892	137·330	51·33, Roscoe.
Yttrium	—	—	30·85, Bahr and Bunsen.
Zinc	406·591	63·690	[406·591, Erdmann, adopted by Berzelius; 414·0, Jacquelain; 412·5, Favre.]
Zirconium	419·728	67·260	[419·728, when, as regarded by Berzelius, zirconia is Zr_8O_8.] According to De Marignac and Dumas, Zirconia is ZrO. Then the atomic weight is 22·4.

(To be continued).

NOTICES OF BOOKS.

Alkali Act, 1863: *Sixth Annual Report, by the Inspector (Dr. R. Angus Smith, F.R.S.) of his Proceedings during the year* 1869. Presented to both Houses of Parliament by command of Her Majesty. London: 1870.

THE work before us, in common parlance a *blue book*, will, we greatly fear, not receive that due appreciation of its merits which its highly valuable contents deserve. It is not merely an official report of duties often performed simply according to a well-established routine; on the contrary, we have to deal, in the first place, with a scientific monograph on the condition of the air in various places exposed to the influence of manufactures, and also on the condition of the air where manufactures do not exist. The eminent author has attempted to give, and we may even say, judging from the pages before us, well succeeded in giving, such an account of the state of the atmosphere of any given place, that it is possible to say, without difficulty, whether it may be considered as tainted by manufactures, or whether it has a large amount of organic matter in it. Moreover, an answer has, to some extent, been given to the question as to the condition of that matter, as it is of importance to distinguish it from that caused by manufacturing processes. The modes by which the air has been studied are—(1) By the usual examination for the gases, oxygen and nitrogen; (2) carbonic acid; (3) ammonia; (4) ammonia from albumenoid matters; (5) nitric acid; (6) rapidly oxidisable matters; (7) slowly oxidisable matters; (8) chlorides and sulphates; (9) acidity; (10) examination of the rain, including an estimation of all the substances mentioned as in the air, the gases excepted.

The author's work is so full of interesting matter, and the results are so condensed, that we regret to say that the ensuing *embarras de richesse* prevents us quoting here more than a mere drop, so to say, from an ocean of valuable and highly-interesting results. The average quantity of hydrochloric acid in rain, in parts per million, varies from 0·97 at Darmstadt, to 25·74 at Runcorn; while at London it is 1·25, and in Scotland (sea-coast and inland country places) 7·95. The distance from the sea mainly governs the amount of chlorine. Total acids of chlorine and sulphur, the relation to the average of that from Row, Dumbartonshire, being taken as unit (1) we find—England (inland places), 1¾; Scotland (sea-side and inland places), 2; Germany (some specimens), 3¼; London, 4¼; Liverpool, 9¼; Runcorn, 10; Newcastle-on-Tyne, 10¼; near an alkali works, 15¼. The acids here meant are both the combined and the uncombined. *Air—Total Acid* (relation to Blackpool taken as 100).—London, 289; St. Helen's, 474; Manchester, 527; Underground Railway (Metropolitan), 1483. *Air—Hydrochloric Acid* (relation to Blackpool taken as 100).—Buxton, 247; London, 320; St. Helen's, 516; Underground Railway (Metropolitan), 974. *Air—Sulphuric Acid* (relation to Blackpool taken as 100).—Didsbury, 320; London, 361; Manchester, 549; Underground Railway (Metropolitan), 1554. *Air—Total Ammonia* (relation to Inellan taken as 100).—London, 117; a bedroom, 179; Glasgow, 202. These scanty instances, taken at random from the large number of tabulated results, may convey some, but, we are bound to say, a very imperfect, idea of the contents of the first and main portion of this valuable treatise. The second portion of this work is devoted to the subject of the condensation of hydrochloric acid at the alkali works.

Our readers will recollect that the Alkali Act of 1863 was made law with the view of enforcing a proper system of condensation of hydrochloric acid, and to prevent neglectful escape of gas. This end, we are glad to see, has been very well arrived at; and, as a proof of the genuine desire on the part also of the manufacturers, to attain a high efficiency of condensation, we are informed that, at two works in the Newcastle-on-Tyne district, permanent structures have been erected, at a cost of £10,000 for each alkali work. There are added to this valuable Report large lithographic plates representing the structures alluded to.

CORRESPONDENCE.

FILTRATION OF STRONG ACIDS.

To the Editor of the Chemical News.

SIR,—As some of your readers may, like myself, have found considerable difficulty in the filtration of the strong mineral acids, I take this opportunity of acquainting you with the mode by which I think this can best be accomplished.

Into the narrow part of an ordinary glass funnel, spun glass (such as is used in making tails for glass birds) is closely packed, and over this is sprinkled ground glass to the depth of a quarter of an inch, care being taken that both the funnel and glass are perfectly clean. About 4 ounces of boiling water are then allowed to pass through the filter, which is then allowed to dry, and, previous to being used, is moistened with a pure specimen of the acid to be filtered.

A filter so constructed is as efficient as any with which I am acquainted, is very durable and cheap, while, from the fact that these acids do not act on glass, freedom from contamination during the process is perfectly ensured.

I may mention that such filters, or the materials necessary for their preparation, may be obtained at Mr. Motherwell's, 73, Union Street, Glasgow.—I am, &c.,

JAMES ST. CLAIR GRAY, M.B., C.M.,
Assistant to the Professor of Forensic Medicine, Glasgow University.

MISCELLANEOUS.

Hydrated Chloride of Aluminium as an Antiseptic.—We learn that a strong solution of this substance is coming into use as an antiseptic. The advantages which it possesses are that it is non-poisonous and devoid of smell, being, at the same time, a powerful antiseptic. It is to be met with in commerce under the name of "choralum."

The Ladies' Medical College.—The seventh annual session of study will commence with an introductory

address by J. A. R. Newlands, Esq., F.C.S. The address will be given at St. George's Hall, at three o'clock on Monday, October 10th, and the chair will be taken by Dr. Ross. The general public are invited to be present. Intending students should apply to the Lady Secretary of the Female Medical Society, at the Offices, 164, Great Portland Street, W.

New Works on Chemistry, &c.—The following are amongst the new works Messrs. Churchill are preparing for publication:—"A Manual of Botany," by Robert Bentley, Professor of Botany, King's College, London, and to the Pharmaceutical Society (second edition). "A Laboratory Text-Book of Practical Chemistry, or Introduction to Qualitative Analysis;" a guide to the course of practical instruction given in the laboratories of the Royal College of Chemistry, by W. G. Valentin, F.C.S. "Handbook of Volumetric Analysis, or the Quantitative Estimation of Chemical Substances by Measure," by Francis Sutton, F.C.S., Norwich (second edition, much enlarged). "The Year-Book of Pharmacy," containing the proceedings at the yearly meeting of the British Pharmaceutical Conference, and a Report on the Progress of Pharmacy, which will include notices of all Pharmaceutical papers, new processes, preparations, and formulæ published throughout the world.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

[In consequence of the war on the Continent, several of the foreign journals have failed to reach us; we shall, however, give abstracts of them as soon as they are received.]

Comptes Rendus des Séances de l'Académie des Sciences, September 12, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and allied sciences:—

What are the True Chemical Agents to be Used as Antiseptics?—M. Faye.—This paper contains a lengthy review on the mode of action of several substances used as disinfectants and antiseptics, and especially as regards the action of phenol (carbolic acid); but the author himself states that he did not think he could say anything new. A discussion arose on this subject, the speakers being MM. Dumas and Chevreul. The former *savant*, in the first place, observed that the author had forgotten that carbolic acid was used largely, and that its application was compulsory in some instances, as well as the use of bleaching-powder. Phenic acid acts, said the eminent speaker, in a double way—viz., by arresting the decomposition of albuminous and other organic compounds, in a manner somewhat analogous to tannin; and, secondly, by killing organic, as well as organised, germs and sporules of all sorts—and thus acts as antiseptic. The speaker advocates the simultaneous application of chlorine (fumigations) and of carbolic acid. M. Chevreul spoke at length on the difference of mode of action of various antiseptics and disinfectants, calling, first, attention to the fact that sulphurous acid and sulphuretted hydrogen, when mixed together and decomposing each other, are mutually disinfectants; that hydrochloric acid and ammonia are in a somewhat similar relation to each other; that charcoal acts as antiseptic in a different manner—viz., by its capillary action; while the action of carbolic acid is chiefly confined to the material source of bad smell, but not to the bad smell actually itself. The venerable speaker next entered into a series of details of researches made by him as far back as the year 1809, on the action of tannin and tanning materials, and on the peculiar action exerted upon animal matters even by such substances as chloride of iridium, bichloride of mercury, chlorine-water, salts of alumina, glucina, and others, all of which possess, in a greater or less degree, astringent taste, and a peculiar property of combining with animal matters and, as consequence thereof, acting as antiseptics and antimiasmatics.

Observatory at Montsouris.—H. Sainte-Claire Deville.—This *savant* communicates, with great regret, that, in consequence of the operations for the defence of Paris, this establishment has been dismounted, the instruments, books, and records having been placed in safety, by order of Admiral Méquet, who is the commanding officer of that portion of the fortifications wherein this observatory (partly a wooden building) is situated.

Proper Means of Counteracting the Effects of Insufficient Food.—M. Rabuteau.—This paper, although strictly belonging to physiology, contains some very valuable matter on the beneficial action of coffee and cocoa. The author records a series of experiments and facts taken from actual daily experience; and he suggests that man may live for several months, and keep active, strong, and healthy, by consuming daily 150 grms. of a mixture (dry) of—Powdered cocoa, 1000 grms.; infusion of coffee, 500; infusion of tea, 200; sugar, 500 grms. The two infusions, as strong as can be made, to be evaporated to dryness previous to being mixed with the rest of the substances; so that the whole weight of this 2200 grms. would be only about 1600 grms., and would be sufficient food for ten days, to be taken mixed with some boiling-water. The author states that it is highly agreeable, he having purposely experimented with this mixture upon himself while abstaining from other food.

Journal für Praktische Chemie, No. 13, 1870.

This number contains the following original memoirs and papers:—

Simple Method of Separating the Acids of Niobium and Ilmenium from each other.—R. Hermann.—The author describes, at length, a process of separation of the bodies alluded to, which is based upon the more difficult solubility of the double fluoride of potassium and ilmenium, as compared with the solubility of the double salt of potassium and niobium, the former requiring 20 parts of water at 10° for solution, while the latter is completely dissolved by 15 parts of that fluid at the same temperature. The author also describes a great many of the soda-salts of both acids.

Composition of the Columbite from Bodenmais (Bavaria).—R. Hermann.—This paper contains the lengthy description of the method of analysis employed for determining the constituents of a mineral which, in 100 parts, contains—Stannic acid, 0·36; tantalous acid (*tantalize säure*), 24·23; niobic acid, 36·93; ilmenic acid, 18·84; protoxide of iron, 14·11; magnesia, 1·27; oxide of copper, 0·13.

Composition of Ferro-Ilmenite, from Haddam, Connecticut, U.S.—R. Hermann.—The mineral alluded to is a tough, compact substance, without any appearance of crystallisation; black-coloured; non-transparent; sp. gr., 6·28; and containing, in 100 parts—Stannic acid, 0·50; tantalic acid, 40·95; hypo-niobic acid, 16·23; hypo-ilmenic acid, 23·74; protoxide of iron, 14·30; protoxide of manganese, 4·28; and very small quantities of tungstic and titanic acids.

Composition of Samarskite.—R. Hermann.—This mineral, also belonging to the same series as those above alluded to, was found to contain, in 100 parts—Stannic acid, 0·35; titanic acid, 7·39; tantalic acid, 7·19; hypo-ilmenic acid, 19·84; hypo-niobic acid, 25·10; thorina, 4·47; yttria, 14·0; protoxide of uranium, 10·58; protoxide of iron, 10·70 magnesia, 0·34.

The above-quoted papers are valuable on account of the exhaustive description which is given of the methods of analysis of these very complex native compounds.

On Isoclase and Kollophane, two New Phosphates.—F. Sandberger.—The author begins by stating that, for more than eighty years there has been, in the mineralogical collection at Würzburg (Bavaria), a specimen kept labelled as "white arsenic," from Joachimsthal; it occurred to him that this might be an error, especially as the mineral did not exhibit quite the characteristics of white arsenic. After referring, at length, to purely mineralogico-crystallographical particulars, the following analysis is quoted of this mineral, the sp. gr. of which is 2·92—Water expelled at 100°, 2·06; water lost at red heat, 18·53; lime, 49·51; phosphoric acid, 29·90: formula, $4CaO.PO_4+5HO$. The author states that he does not doubt that this mineral has really been found at Joachimsthal, in Bohemia, and desires that the attention of the Austrian mineralogists should be directed to that locality, where, perhaps a larger quantity of this mineral may occur. Kollophane is a peculiar mineral occurring at Sombrero (an island belonging to the United States), and consisting, in 100 parts, of—Water expelled at 100°, 3·36; water expelled at red heat, 1·66; lime, 50·70; magnesia, 0·80; phosphoric acid, 39·10; carbonic acid, 3·96.

The following subjects are all communicated by Dr. Bœttger:—

Anthracen Orange.—While experimenting on the preparation of alizarine from anthracen, the author found a new compound, the constitution of which he has not yet fully ascertained; but the new body contains nitrogen, and is obtained by first preparing a nitro-compound of anthrachinon by treating that substance, in pure state, with a mixture of equal parts of very concentrated nitric and sulphuric acids, and submitting it to a temperature of 40°. The anthrachinon dissolves; and, as soon as dissolved, the liquid is poured into a large quantity of water, by which operation the pure nitro-compound is precipitated as a bulky, yellow-coloured, flocculent body. This, having been collected on a filter, and washed, is next placed in a porcelain basin, and there is poured over it a solution of protoxide of tin in caustic potassa or soda. This solution first causes the appearance of an emerald-green coloured fluid, which, on continued boiling, deposits the beautiful cinnabar-red coloured substance. This, after having been collected on a filter, and well washed and dried, fuses at about 225°, and sublimes as a beautifully red-coloured crystalline matter, soluble in acetic ether, aceton, chloroform, aldehyde, ordinary ether, alcohol, and wood spirit. This pigment is also soluble, without decomposition, in strong sulphuric acid, as well as in nitric acid (sp. gr., 1·2).

Behaviour of Anthrachinon to Nascent Hydrogen.—When anthrachinon is treated with pulverised metallic zinc and a boiling

solution of caustic potassa or soda, it is reduced to anthracen, with the exhibition of a very brilliant red colouration, which only subsists as long as it is in contact with zinc.

Simple Method for Purifying Metallic Arsenic.—In order to restore to this metal its bright aspect, and also for the removal of any slight coat of suboxide which may adhere to it, the author advises that the metallic arsenic should be boiled for a few minutes in a moderately-strong solution of bichromate of potassa, slightly acidified with sulphuric acid. The metal is next first washed with water, and then with alcohol or ether, and lastly placed in a small tube closed at one end, and sealed immediately after the arsenic has been put into it. Phosphorus, which has been kept a long time under water, and has become thereby coated with a whitish yellow crust, may be treated in the same way, when it becomes quite colourless again. The phosphorus should be, of course, carefully treated, so as to prevent its ignition; and, after having been well washed with cold water, should be preserved in water freed from air by having been previously boiled for a long time and cooled in a well-closed vessel.

Behaviour of Protochloride of Copper when Electrolytically Decomposed.—When protochloride of copper is placed in weak hydrochloric acid, and submitted to electrolysis, the electrodes being made of copper, the anode becomes covered with snow-white crystals of chloride of copper, while there is deposited on the cathode a thick layer of very loosely-adhering spongy metallic copper. When the latter is well washed, and next placed in a small flask along with a filtered solution of bleaching powder (hypochlorite of lime), that salt is partly decomposed, yielding, at first, very pure oxygen gas, but afterwards a gas (not specified) which extinguishes the light of a burning taper.

Very Sensitive Test for Hyposulphites.—Dissolve 1 decigrm. of very pure permanganate of potassa, and 1 grm. of perfectly pure soda (prepared from sodium) in ½ a litre of distilled water; there is thus obtained a perfectly red-coloured liquid, which, upon the addition even of a very minute trace of any hyposulphite, becomes, at once, green. This test, the author states, is so delicate, that traces of a hyposulphite present in neutral sulphites may thus be detected.

Employment of Pulverised Magnesium as a Powerful Reducing Agent.—The chlorides of many metals are, when brought into contact with pulverised magnesium, readily reduced to the metallic state. Not only does this apply to the chlorides of gold and platinum, but even to that of zinc.

Preparation of Coloured Cements which Harden Rapidly.—The author takes a solution of silicate of soda (sp. gr., 1·298), and adds to it, whilst stirring, first pulverised and previously washed, lixiviated chalk, so as to form a thick mass, like butter, to which are added, for colouring purposes, the following substances:—Finely-pulverised sulphuret of antimony for black, iron filings for grey, zinc dust for whitish grey, carbonate of copper for bright green, oxide of chromium for deep green, cobalt blue for blue, red-lead for orange, vermillion for bright red, and carmine for a violet hue. This cement hardens within from six to eight hours, and may afterwards be polished, becoming like marble.

On Diastatic Ferments.—V. Wittich.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, Nos. 6 and 7, 1870.

These numbers contain the following papers relating to physico-chemical and allied sciences:—

Reports on the Researches of MM. Cornet and Briart on the Millstone-Grit of Bracquenies (Hainaut, Belgium).—MM. d'Omalius, De Koninck, Dewalque, Horion, and Gosselet.—These papers are only of local geological interest.

Elastic Force of Liquefiable Gases.—M. Melsens.—This paper contains the results of a few researches made by the author while experimenting with condensed liquefied gases at higher temperatures, and employing, for the estimation of the pressure, metallic manometers. Liquid carbonic acid exerts, at 100°, a pressure equal to 228 and 86-100ths atmospheres (each atmosphere equal to 15 lbs.' pressure per square inch). The author observes that, unless the space above the liquid gas be sufficient for the proper expansion of its vapour, the pressure, even at from 40° to 45° (equal to from 91 to 100 atmospheres), may rise to 300 atmospheres, and, consequently, become highly dangerous as regards the chance of explosions.

Existence of Natural Pits in Senonian Chalk Formation of Brabant.—F. van Horen.—This paper, illustrated by lithographed plates, treats on a subject before alluded to by us while quoting a former number of this periodical (see CHEMICAL NEWS, vol. xxii., p. 119).

Vitality of Beer Yeast, and on the Vitality of the Jennerian Vaccine Lymph.—M. Melsens.—As regards the beer yeast, the author states that his former experiments are fully confirmed (these experiments were made in 1866 and 1868). Jennerian vaccine lymph, exposed for an hour to artificially-obtained cold of −80°, was found to have preserved its vitality.

Geological Description of the Empire of Morocco.—M. Mourlon.—A lengthy essay, from which we learn that, among other industrially-valuable minerals, Morocco contains large deposits of rock-salt.

Annalen der Chemie und Pharmacie, July, 1870.

This number contains the following original papers and essays:—

Researches on Isomerism in the Benzol Series.—F. Beilstein and A. Kuhlberg.—Eleventh paper on this subject, divided into the following sections:—Para-nitrotoluol, $C_6H_4(NO_2)p.CH_3$; meta-nitrotoluol, $C_6H_4(NO_2)m.CH_3$; dinitrotoluol-sulpho acid, $C_7H_5(NO_2)_2SO_3H$.; ortho-nitrotoluol, $C_6H_4(NO_2)O.CH_3$.

Action of Bromine upon Dichlorhydrine.—L. Carius.—After referring, at some length, to his former researches on this subject, the author describes two bodies, which result from the action of bromine upon dichlorhydrine. One of these substances is brom-dichlorhydrine, which it is difficult to obtain in pure state. The other body is dichlor-dibrom-acetone, $C_3H_2Br_2Cl_2O$; in hydrated state, it contains $(OH_2)_4$ in addition; it is a very hygroscopic body, which crystallises in large crystals soluble in alcohol and ether, but difficultly so in water and benzol. The paper contains an exhaustive account of the reactions and products of decomposition and derivatives of this body.

On Toluylen-Oxide, or Desoxybenzoine, $C_{14}H_{12}O$.—H. Limpricht and H. Schwanert.—This essay is divided into the following sections:—Toluylen-hydrate, $C_{14}H_{14}O$; toluylen, $C_{14}H_{12}$; acetyl-toluylen-hydrate, $C_{14}H_{13}(C_2H_3O)O$; bromated toluylen-oxide, $C_{14}H_{11}BrO$; bibromated toluylen-oxide, $C_{14}H_{10}Br_2O$.

Benzilic Acid, or Diphenyl-Glycolic Acid.—Dr. A. Jena.—This paper contains the detailed description of benzilic acid, $C_{14}H_{12}O_3$, a solid, crystalline body, fusing at 150°, readily soluble in alcohol, ether, and boiling water, but difficultly in cold water. The author also gives an exhaustive account of a series of the salts of this acid, and treats, at length, on diphenyl marsh gas (*sumpfgas*), $C_{13}H_{12}$.

On Benzoine.—A. Jena and H. Limpricht.—This memoir is divided into the following sections:—Acetyl-benzoine; toluylen-alcohol; ethyl-benzoine; ethyl-benzilic acid, $C_{14}H_{11}(C_2H_5)O_2$.

On Dibenzoyl.—Dr. A. Jena.—This paper contains the critical review of the labours of various experimenters on this body, which, according to the author, is by no means easily prepared; and its existence seems, judging from the results of his labours, somewhat doubtful.

Homologues of Naphthaline.—R. Fittig and J. Remsen.—This lengthy treatise contains the following chapters:—Methyl-naphthaline, $C_{11}H_{10}=C_{10}H_7.CH_3$; methyl-naphthaline-sulpho acid—

$$C_{10}H_6\begin{cases}CH_3\\SO_2HO\end{cases}$$

behaviour of methyl-naphthaline with oxidising agents; ethyl-naphthaline, $C_{12}H_{12}=C_{10}H_7.C_2H_5$; ethyl-naphthaline-sulpho acid—

$$C_{10}H_6\begin{cases}C_2H_5\\SO_2HO.\end{cases}$$

Contribution to Our Knowledge of some kinds of Sugar.—H. Hlasiwetz and J. Habermann.—This memoir, too lengthy, like most of the preceding, for any useful abstraction, treats on—Glucose; formation of gluconic acid, $C_6H_{12}O_7$; various salts of gluconic acid; sorbine; levulose; glycerine; phloroglucine.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles (No. 152), August 15, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and collateral sciences:—

Notice on the Levelling and Survey executed with very great Precision in Switzerland.—MM. Hirsch and Plantamour.—This paper contains an interesting account of the labours of a committee of scientific men and engineers, who, acting upon the suggestion made at an international meeting held at Berlin, in 1864, under the presidency of General Baeyer, set to work to execute, in the Helvetian Republic, a complete and very accurate taking of levels and measuring of altitudes above sea level, and other geodesical labours. The observatory at Berne is situated at 572·14 metres above sea level; the cathedral of Fribourg at 588·66 metres; the town-hall at Chaux-de-Fonds at 989·35 metres.

Glaciair Striæ observed on the Fontainebleau Sandstone, near Paris.—E. Collomb.—A geological essay.

Bulletin Mensuel de la Société Chimique de Paris, August, 1870.

From the *procès verbaux* of the meetings of this Society published in this number, we learn that M. Cornu exhibited an instrument constructed with the view to measure the rotatory power of various substances. In this instrument, the plane of polarisation is not determined by the extinction of an image, but by the equality of the tint of two adjacent images. M. Riban states that he has worked with this instrument, and determined, by its aid, the rotatory power of different samples of amylic alcohol and derivatives thereof. The amylic alcohol obtained from rice exhibited, at 22°, a rotatory power equal to −1° 18′; −1° 19′; −1° 20′; and, after having been heated to 240° for forty hours consecutively, the rotatory power of this alcohol was yet equal to −1° 18′; and, even when the alcohol was heated to 300° for 27 hours, its rotatory power was not perceptibly decreased. The valerianic aldehyde obtained from the levogyric alcohol was dextrogyric, exhibiting a rotatory power equal to +2° 34′ (the sp. gr. of the liquid, at 22°, being 0·799, and its boiling-point 93°). The valerianic acid derived from this aldehyde has a rotatory power of +1° 53′ (the sp. gr. of the acid, at 22°, is 0·43). Amylen exhibits no rotatory power at all.

This number contains the following original papers and memoirs:—

Researches on the Ethers of the Arsenic Acids.—J. M. Crafts.—This paper is identical with that already quoted (see CHEMICAL NEWS, vol. xxii., p. 96).

Thermical Researches on Sulphur.—M. Berthelot.—The contents of this paper have already been referred to by us from the *Comptes Rendus* (see CHEMICAL NEWS, vol. xxi., p. 214).

New Method for the Synthesis of Organic Acids.—M. Berthelot.—The direct action of the oxidation of the ethylenic and acetylenic carbides of hydrogen has the effect of first forming aldehydes and acetones. Any ulterior action produces monobasic acids, while the free hydrocarbons produce, under the influence of an alkaline permanganate, bibasic acids.

Meta-Naphthaline.—M. Berthelot.—MM. Pelletier and Walter gave, some years ago, this name to a substance obtained from the tar from a resin gaswork. The author got, from M. Dumas, a sample of this substance, preserved in the Museum of the Sorbonne, and found, on testing its properties, that these agreed with the description thereof published by the first-named gentleman (see *Ann. de Chim. et de Phys.*, 2nd series, vol. lxvii., p. 298, 1838). The author found, on further investigation, that this meta-naphthaline is a mixture of various carbides, none of which are identical either with phenyl or any of the well-known carbides which are obtained from coal-tar. The substance in question, though beautifully crystalline, is an ill-defined mixture of a variety of bodies, the identification of which yet occupies the author.

An Aromatic Glycol.—E. Grimaux.—This lengthy paper is divided into the following sections:—Chloride of tollylen—

$$C_8H_8Cl_2 - C_6H_4 \begin{cases} CH_2Cl \\ CH_2Cl \end{cases}$$

bromide of tollylen, $C_8H_8Br_2$; iodide of tollylen, $C_8H_8I_2$; diacetate of tollylen—

$$C_{12}H_{14}O_4 = C_6H_4 \begin{cases} CH_2.OC_2H_3O \\ CH_2.OC_2H_3O \end{cases}$$

mono-benzoate of tollylen—

$$C_{15}H_{14}O_3 = C_6H_4 \begin{cases} CH_2.OC_7H_5O \\ CH_2OH \end{cases}$$

tollylenic glycol—

$$C_8H_{10}O_2 - C_6H_4 \begin{cases} CH_2OH \\ CH_2OH \end{cases}$$

Full Description of an Apparatus for Measuring Rotatory Power.—A. Cornu.

Decomposition of Oxalic Acid.—M. P. Carles.—This paper is mainly the same as the author's memoir published in the *Comptes Rendus*, and quoted in CHEMICAL NEWS, vol. xxii., p. 58.

Reply to the Critical Review of M. Reindel's Paper "On Ferrocyanides."—G. Wyrouboff.

Some of the Properties of Albumen of Eggs.—A. Petit.—After referring to researches on this same subject published some years ago, the author treats on the action of acids and alkalies on albumen, stating that these reagents, while combining with albumen, produce its dehydration, thus effecting a molecular rather than real chemical change. Animal charcoal (this is incidentally observed) has the property of absorbing albumen either from neutral, acid, or alkaline solutions; and this property, the author states, may be rendered available in analysis of vegetable and other substances.

Les Mondes, September 8, 1870.

General Extension of the Dry Season of 1870. M. du Peyrat.—In a letter to M. Marie-Davy, the author states that he travelled from the Island of Réunion to Aden, thence through the Red Sea and the Suez Canal and the Mediterranean, and that during this twenty-six days' journey he has not felt a drop of rain. The ordinary rainy season at Réunion has been absent this year altogether, no rain having fallen for eleven months consecutively. At Aden, no rain had fallen for eighteen months; and the large rain-water cisterns which are kept for the purpose of water supply there were quite empty, and all vegetation had disappeared. The same was seen at Suez, and along the canal, except in the valley of the Nile.

Health of Baron von Liebig.—We are happy to learn that the health of this eminent *savant* is so far restored that, although very weak, he is able to take some exercise, and intends to go shortly to Engadine, Switzerland, to stay there and enjoy the fresh country air.

Peat and Peat Bogs.—M. Diesbach.—The author describes, at great length, a machine contrived to render the utilisation of peat as fuel a more readily manageable and, at the same time, economical business. He is at present very successfully engaged in working the peat bogs of Calsonaye Echallen, Canton du Vaud, Switzerland, producing a fuel which heats as much as absolutely dry wood. The author's machinery may be, perhaps, a boon to Ireland and other countries where peat bogs abound. From the statements made in this paper, there is no reason to doubt the efficacy, as well as the suitableness of the process; Switzerland, moreover, is a country where fuel is scarce and cheapness a foremost requisite.

Constant Galvanic Element with One Liquid.—M. Delaurier.—This lengthy memoir, illustrated with woodcuts, contains the description of a series of experiments made with this galvanic element. The author employs—Chromate of soda, 5 parts; water, 40; and sulphuric acid, 14 parts.

Journal für Gasbeleuchtung, July, 1870.

This number contains the following original papers and memoirs relating to chemico-physical and collateral sciences:—

Quantity of Water Yielded by Artesian Wells.—A. Thiem.—This paper is a lengthy essay reviewing the various algebraical formulæ relating to hydrostatics and hydrodynamics.

Construction of Gas Meters according to the Metrical System; and on the Conversion of Gas Meters made upon the English and Rhenish Cubic Foot System into Metres according to the Metrical System.—T. Spielhagen.

Tin-Lined Lead Tubing.—Dr. Schilling.

NOTES AND QUERIES.

Soap Making.—I am a "soft soap" maker, and am anxious to have a book or treatise on the subject, or on soap-making generally and oils and fatty matters; can you direct me to the best? Also, particularly, the experiments of Mr. Clift (referred to in CHEMICAL NEWS, vol. x., p. 55) for the "sweeting of fish oils."—J. Y.

Artificial Alizarine.—I should feel favoured if any correspondent would kindly answer the following:—In the year 1861, provisional protection was obtained for the manufacture of artificial alizarine by Mr. T. J. Roussin. His process was by acting on what he called binitronaphthaline (obtained by causing naphthaline to react upon a mixture of azotic and sulphuric acids) with concentrated sulphuric acid and a metal. I should like to know if there was any foundation for this specification; if so, the nature of the colouring matter produced (specification, May 17th, 1861; No. 1266). These attempts are interesting now that the manufacture of alizarine has become an accomplished fact.—R. G. BENNETT.

Decomposition of Fulminate of Mercury.—(Reply to "C. H.")—This compound, which consists of 86 per cent of suboxide of mercury, and 14 per cent of fulminic acid, can be readily decomposed, so as to prevent any danger of explosion, by treating it—for instance, with hot nitric acid, whereby carbonic and acetic acids are formed and nitrate of mercury; or, by applying hydrochloric acid, whereby mercuric chloride and mercurous oxalate are formed. Moderately dilute sulphuric acid also decomposes it without detonation, but with rise of temperature and evolution of gas. The ensuing mercuric compounds can be readily converted into metallic mercury, by boiling with water in a clean iron vessel containing iron nails.

Hard and Soft Water.—Two or three weeks ago, a communication appeared in one of the leading journals, recommending the use of soft water in drinking and cooking purposes. Whatever value such an opinion may possess in a scientific point of view, there is reason to fear that, practically, it is not without danger to the public health. There is an idea, very prevalent amongst the non-informed portion of the public, that "soft water" means *rain-water*, which generally washes the blacks and other impurities from the tops of houses before it is drawn for use, and is certainly not the purest channel for conveying drinking-water into our houses. As the paragraph referred to was circulated freely at the time of its appearance, a few words of caution from you, Sir, may put people on their guard.—SANITAS.

Decomposition of Nitrate of Ammonia.—Would you inform me, through through your Answers to Correspondents, what the products or educts of the distillation of nitrate of ammonia are, besides N_2O; is it possible to get N_2O_3 (nitric anhydride) and N''_2O_4 (nitric oxide). A friend makes the N_2O for anæsthetical purposes, and employs three Wolff's jars; the first, nearest the retort, he has KHO or NaHO in, to take up nitric acid or anhydride, which he says is formed (would not OH_2 absorb it ?); the other has a solution of SO_4FeO" to purify the N_2O from N''_2O_4. Is he correct? From what I have read in Dr. Frankland and Fownes, under the article N_2O, the equation is thus:—$NO_2(N'H_4O) = 2OH_2 + ON_2$ (Frankland's). Would you (if this equation is incorrect) give me a proper equation, and oblige—A YOUNG STUDENT.

TO CORRESPONDENTS.

T. H. Page.—The work is not published yet; it is a general work on Dyeing, &c.

Subscriber.—It is considered successful.

J. Slessor.—The allowance will be made.

W. Arnot.—Received.

J. Edwards.—The notice appears in this week's number.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

Silicates of Soda and Potash in the state of Soluble glass, or in CONCENTRATED SOLUTION of first quality, suited for the manufacture of Soap and other purposes, supplied on best terms by W. GOSSAGE and Sons, Widnes Soapery, Warrington.

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THE CHEMICAL NEWS.

Vol. XXII. No. 567.

ON THE DISCRIMINATION OF FIBRES IN MIXED FABRICS.*

By JOHN SPILLER, F.C.S.

It is often a matter of importance to separate or distinguish the fibres of silk, wool, cotton, jute, &c., when interwoven, or composing the structure of mixed fabrics, and much progress has been made towards the identification of such fibres by the close examination of them under the microscope. With the view of aiding such enquiries, I beg leave to point attention to some new chemical tests, by means of which the character of the component fibres in mixed goods may be very readily determined. At the outset, I may state that there are many processes of examination which are already known to, and employed by, practical dyers, such methods usually depending upon the comparative facility with which certain colouring matters are taken out of a dye-bath, by virtue of special affinities exerted between one or other of the component fibres and the dyes exhibited; thus it is well known that indigo, and soluble blues and violets of the aniline series, attach themselves to wool much more freely than to cotton, whilst safflower and regina have a decided affinity for cotton.† The nitric acid test for wool is also well known and often applied, but the use of dilute alkalies for dissolving out wool from silk and cotton has never, in my hands, given satisfactory results.

I proceed at once to indicate the test upon which I rely for the identification of silk when mixed with any other animal or vegetable fibres, which test can, of course, be applied to the detection of inferior staple in a supposed pure silk. The reagent employed is concentrated hydrochloric acid, which I find has the property of dissolving silk immediately and completely, without appreciably affecting any woollen or lignine fibres (cotton, linen, jute, &c.) with which the silk may have been interwoven. Strong sulphuric acid has also a powerful solvent action upon silk, but its effect upon cotton is much more destructive than in the case of hydrochloric acid. The use of these acids for the purpose of testing the quality of silk has been frequently resorted to by my friend, Mr. James Kayess, of the Garratt Print Works, near London, and myself during the past three years, and, in conjunction with the gentleman I have named, the original experiments were made upon which the efficacy of this method of testing silk was clearly established.

Having, then, submitted the material to the action of hydrochloric acid, and noted any indications of rupture or solution of the fibres, the residual fabric or loose filaments may now be washed and collected, and will usually be destitute of colour. We have next to determine the presence or absence of wool in that portion of the fabric which resists the attack of hydrochloric acid; and, for this purpose, I know of no better test than the use of picric acid, as recommended by Professor Pohl, of Vienna, and fully described in Watts's "Dictionary of Chemistry," vol. v., p. 1047. A warm aqueous solution of picric acid instantly imparts a full yellow tint to wool, but does not in the least affect cotton, linen, jute, or China grass, so that it is only necessary to immerse the fabric or fibres in the dye, wring out, and wash well with water in order to remove the adhering yellow solution, and note any indications of the existence of wool. I have ascertained that cotton may be so treated without retaining any trace of the colour, and that a previous digestion in hydrochloric acid in no way affects the result. In the examination of ribbons, and some other stiffened goods, it is often necessary to immerse them for a few minutes in boiling water, to dissolve out the starch or size prior to applying the hydrochloric acid test, for, by this simple expedient, the results are rendered much more decisive.

The above will be deemed the readiest mode of proceeding, but it will be well to mention other methods of distinguishing between wool and cotton. We can use, for instance, an acidulated solution of Hofmann violet or of soluble blue; iodine green may be employed, or, lastly, the Nicholson blue, which, applied in alkaline solution, is much more readily taken up by wool than by cotton. As means of confirmation, the use of any one of these dyes may be resorted to, and a direct comparison instituted, if necessary, with known materials.

By the system of examination just now described, I have examined a large series of mixed fabrics and coloured goods, without observing any difficulty in the detection of the silk and wool entering into the constitution of such materials. With respect to the identification of the fibres which remain unaltered by this treatment—the discrimination of cotton from flax, for instance—I have hitherto relied upon their structural peculiarities as indicated more conspicuously by the microscope, and this part of the subject has, besides, been fully treated of by Mr. W. T. Suffolk, in his recent work, entitled "Microscopical Manipulation."

By way of conclusion, I append a short description of the chemical properties of the solution obtained by acting upon silk with hydrochloric acid. The mucilaginous liquid so prepared cannot be evaporated, even over a water-bath, without becoming somewhat carbonised; the free acid may be partially separated by dialysis, or by exposure to air in a shallow capsule, placed within a bell-jar charged with a liberal supply of slaked lime to absorb the hydrochloric fumes, but the resulting solution will not then bear dilution with water without precipitation of the animal matter. Ammonia, added in excess, forms a clear solution, which I am hopeful of being able to employ in photography, for when this liquid is evaporated there is left a brown saline residue of rough astringent flavour, which, when mixed with aqueous nitrate of silver, gives a peculiar flocculent form of argentic chloride, which is no longer curdy, and much more rapidly affected by light than the ordinary condition of chloride of silver. These properties enable the silk-compound to be usefully employed in the production of "matt-paper" prints and direct solar-camera enlargements. Its application to the collodio-chloride process appears also to be worthy of trial.

When caustic soda in excess is added to the silk-solution, and afterwards a small proportion of the sulphate, or, better, the sodio-tartrate, of copper, a fine purple colouration is observed, which is permanent, and seems to afford a characteristic indication of the nature of the animal substance dissolved. No red cuprous oxide is thrown down upon boiling this solution. A white precipitate is formed when the solution of silk is neutralised with a caustic or carbonated alkali, and the product exhibits a considerable affinity for dyes, as does also the mixed substance resulting from the addition of an *acid* solution of silk to an *alkaline* solution of wool. In the latter case, however, the evolution of sulphuretted hydrogen will be noticed as an unfavourable feature of the reaction, and probably indicates the breaking up of the constitution of the wool. The brownish uncrystallisable residue left upon evaporation of the pure silk-solution reacts strongly acid to test-papers, and has, whilst warm, an odour suggestive of caramel; when strongly heated, it burns with a brilliant flame, giving off the well-known odour of singed hair or feathers, like many other nitrogenous animal substances. The preparation of the new silk-compound on a large scale, and in the state of purity, has

* Read before the British Association, Liverpool Meeting, Section B.

† The new "Spiller purple" likewise shares the property here referred to, going well upon cotton without any mordant.

hitherto presented difficulties on account of the peculiar nature of its properties, and the liability to become charred in the process of evaporation.

ON THE

SEPARATION OF PHOSPHORIC ACID FROM IRON ORES AND IRON CINDERS.*

By JAMES HARGREAVES.

I NEED not here enter into any lengthened description of the evil effects of phosphorus upon iron; suffice it to say that iron containing phosphorus in appreciable quantities is utterly unfitted for the manufacture of steel, and is considerably deteriorated whether it is used in the form of cast or malleable iron. Hence it is desirable to get rid of the phosphorus to prevent this deterioration.

This subject had to some extent attracted my attention for several years, but not so far as to make it a matter of especial study and experiment, but, about five years ago, my attention was more closely drawn to the subject, and I proposed the use of alkaline nitrates as a means of converting cast-iron into steel, and, at the same time, separating any phosphorus that might be present. By the use of nitrate of soda I have found it to be quite practicable to produce a good serviceable steel direct from phosphoric pig.

The process, however, was not carried out on a real working scale, for reasons entirely apart from its technical merits, to explain which would be to go into personal matters, which are quite foreign to the objects of this association. But while engaged in the attempt to develop this steel process, the fact forced itself upon my attention that phosphorus had hitherto been too much looked upon as something to be *got rid of*, and not sufficiently as something to be *got hold of*; and that to effect the latter would be the best means of effecting the former. It was talked of and regarded by the iron manufacturers as "dirt," but that was because it was "matter in the wrong place," and the only way to make it cease to be dirt was to put it in the right one. I felt this to be a matter of considerable importance, and have often pressed as a subject of study by my fellow chemists, some commercially practical means of obtaining the phosphorus either alone or in some of its available compounds. I pointed this out in a paper read before the Liverpool Polytechnic Society in November, 1867, and again before the Cleveland Institute of Engineers, at Stockton-on-Tees, in March, 1868. But at the latter place I was simply ridiculed for even alluding to anything so very preposterous, the very fact that there was such an immense amount of phosphoric ores consumed being quoted as a reason why the proposal should be considered impracticable. I refer those who are interested in this subject to the *Engineer* for the earlier part of 1868, for copies of the papers read at Liverpool and Stockton.

It seems, however, that no one has, so far as I can learn, thought proper to give this subject the attention which it deserves—not even those who are most interested in it, and whose opportunities and inducements must be very much greater than my own. In fact, it has almost seemed as if those who would naturally be expected to take the greatest interest in the subject are the last to pay any attention to it. It is one which I was anxious to see carried into practical operation, no matter by whom, as I looked, and still look, upon it as a question of not only pecuniary, but what is immeasurably greater, of vital importance, one affecting health and life, for, in the absence of phosphates, no bony frames can be formed to cover with muscles and endow with vital force; and one of the limits which bound the existence of man and the lower animals is the quantity of phosphoric acid which can be made available and used as a vital "circulating medium."

I need not dilate upon the importance of a large and practically exhaustless source of phosphoric acid, especially so long as our municipal authorities continue to make use of our streams as convenient conveyances to deposit our supplies of phosphates in the sea, instead of using the sewage to re-fertilise the soil which has been exhausted in the production of food. Seeing this waste (which is nothing less than criminal) one would imagine that we did not expect to be followed by future generations, or else that some one had invented some improvement on the work of the Omnipotent, and the framework of the bodies of future generations were to be built up without the use of phosphates at all. By proper utilisation and conservation of the elements of food, whether in the form of excretal matters or of mineral substances, it is possible that to make "every rood of ground maintain its man" may be not only the aspiration of a poet, but a matter of sober fact.

As an illustration of the quantity of phosphorus which is present in the iron made in Great Britain, I may point to Cleveland, which manufactures 1¼ millions of tons of iron per annum. This iron, at the low estimate of 1¼ per cent, contains 18·750 tons of phosphorus, which is equal to 42·943 tons of phosphoric acid. This phosphoric acid is sufficient to supply the phosphoric constituents to 3,400,000 tons of wheat. In the absence of strict statistics on the subject, it is not too much to assume that, in the whole of the British iron manufacture, this quantity might be tripled, with every confidence that it is considerably under rather than over the fact.

When phosphoric pig-iron is converted into malleable iron, the phosphorus is, in great part, transferred to the refinery and puddling furnace cinder in the form of phosphate of iron. The quantity of phosphoric acid varies of course with the composition of the pig-iron from which it is contained. The cinder produced from refining and puddling Cleveland pig contains generally from 3 to 7 per cent of phosphoric acid, which is from one-fourth to one-half the phosphoric acid present in good commercial soluble phosphate of lime. This cinder is sometimes again used for the manufacture of pig-iron, but the product is, on account of the accumulation of phosphorus, of small commercial value, while, if the phosphoric acid were previously separated, it would be capable of yielding iron quite equal to that produced from hæmatite, or could be again used for "fettling" puddling furnaces.

While at this part of the subject I may refer to the contradictory and incoherent theories given to account for the separation of phosphorus from the iron and its transference to the cinder while being converted into malleable iron by the ordinary refining and puddling processes, while in the Bessemer process the amount of phosphorus separated is very small. I could get no satisfactory explanation from other sources, and, therefore, made these reactions a subject of study and experiment for over three years, and I gave the results in a paper read before the Liverpool Polytechnic Society. To repeat this would extend this paper to too great length, and I must refer those who take an interest in the subject to the *Journal* of the Society for May, 1869.

The concentration of the phosphorus from the pig into the cinder in the form of phosphate of iron renders it more easy and practicable to separate when the preparation of compounds of phosphoric acid is the object in view, as there is a smaller bulk of material to be treated to obtain a given amount of product.

The phosphoric acid may be separated either in the form of soluble superphosphates of lime and magnesia or of the alkaline tribasic phosphates. To effect the former the cinder is melted with lime and magnesia; and to do this it is best to either use lime in the furnace during puddling, or else add it at the end of the operation before the cinder is run out, so as to save the fuel required to re-melt it. This is then roasted in the ordinary way of

* Read before the British Association, Liverpool Meeting, Section B.

making what is technically called "bull-dog." By this roasting the protoxide of iron is converted into magnetic oxide or into peroxide of iron, both of which are very slowly soluble in cold dilute hydrochloric acid, while the phosphate of lime is readily dissolved out, leaving the oxide of iron and silica behind. Or, instead of fusing the cinder with lime, it is first dissolved in hydrochloric acid, the silica being left behind insoluble, except a small proportion of gelatinous silica; sufficient lime or chloride of calcium is added to saturate the whole of the phosphoric acid present in the cinder. The chloride of iron is then concentrated to dryness. If in an open reverberatory furnace and in an atmosphere containing water vapour, hydrochloric acid is again liberated, which can be condensed and used again to dissolve more cinder. The peroxide of iron is then heated to redness to render it insoluble, and cold dilute hydrochloric acid added, which dissolves out the phosphate of lime, leaving the oxide of iron nearly pure. If it is desirable to obtain the chlorine in its isolated state instead of in the form of hydrochloric acid, the chloride of iron is dried in a close vessel, and dry atmospheric air passed through it at a temperature about the melting-point of zinc; the chlorine is liberated and peroxide of iron formed. The manufacture of chloride of lime or bleaching-powder can, therefore, be economically carried on in connection with the manufacture of phosphates and pure iron oxide, dispensing with the use of manganese, and with the further advantage that a given amount of hydrochloric acid will produce double the amount of chlorine that can be produced by the use of manganese. To obtain phosphate of soda, I keep the cinder free from lime and grind it to a powder, then I add a solution of caustic soda in good excess, so as to separate the whole of the phosphoric acid from the cinder before throwing the cinder out, and add the solution of phosphate and excess of caustic soda from that to an excess of cinder, so as to convert the whole of the caustic soda into phosphate. The partially exhausted cinder is then again treated with an excess of caustic soda to separate the whole of the phosphoric acid. The diphosphated cinder still contains the silica originally present, and it seems to combine with some of the soda used to dissolve out the phosphoric acid, as there is often 20 per cent of the soda used remaining in the cinder. This cinder may be again used to fettle puddling furnaces, and the soda present in it cannot but facilitate the transformation of the phosphorus in the pig into phosphoric acid in the cinder; the presence of the silica, however, is objectionable, on account of its neutralising a great proportion of the bases present in the cinder. It is desirable that the cinder produced from the fettling and the iron together should be as free as possible from anything which can saturate the basic material, so as to allow of a greater amount of free base, which readily facilitates the formation of phosphate of iron. To allow of this when making phosphate of soda, I dissolve the cinder the same as before mentioned, leaving the insoluble silica behind. The chloride of iron is then dried and used in the production of chlorine, or the hydrochloric acid may be again recovered to use over again. The oxide of iron, *plus* phosphate of iron obtained after the separation of the chlorine, is then treated with caustic soda to obtain solution of phosphate of soda, the practically pure oxide of iron remaining insoluble. The phosphoric acid in the iron ores exists principally as phosphate of lime, which, in fact, is the remains of extinct animals. To separate the phosphate, the ore is roasted so as to render the oxide of iron insoluble. The ore is broken into suitable sized pieces, say about 2 inches cube, and cold dilute hydrochloric acid run through it, which takes up the phosphate into solution, leaving the oxide behind.

The limit to the manufacture of the acid phosphate is, practically, the quantity of hydrochloric acid which is produced in the manufacture of sulphate of soda, over and above what is required for the manufacture of bleaching-powder and a few other purposes. The exact quantity of this acid I have not had time to ascertain with any degree of accuracy, but in the alkali works on the Mersey, and it is much the same in other places, there are literally brooks of hydrochloric acid run to waste; besides, the fact that the acid at present used in the manufacture of bleaching-powder can, by the use of chloride of iron process, be reduced to one-half and, in many cases, to less than one-third, its present quantity, will liberate a still further supply of acid to be used in the preparation of acid phosphates. There is here an opening for the consumption of a great amount of valuable material which is at present run to waste. There is, of course, no practical limit to the further production of hydrochloric acid, whatever may be the quantity required, if a rise in price should occur sufficient to justify its special manufacture, and the manufacture of phosphate of soda is also unrestricted so far as supplies of soda are concerned.

The only objection to the use of such hydrochloric acid as is produced in the course of the alkali manufacture is the presence of arsenic. This, however, is practically a small difficulty, the same person who produces the hydrochloric acid also produces sulphide of calcium in the shape of alkali waste. A current of sulphide of hydrogen (which can easily be produced from the waste) passed through the acid readily precipitates the arsenic in the form of orpiment, for which there is a regular demand at remunerative prices. The separation of the arsenic will, if fairly attempted, more than pay for the cost of obtaining it.

ON MARBLES FROM THE ISLAND OF TYREE.*

By EDWARD C. C. STANFORD, F.C.S.

TYREE is one of the few islands in the Hebrides where limestones are found, and two varieties are sufficiently remarkable to form the subject of this note. Both occur at Balephetrish, on the north-west side of the island, and near the coast. One of these occurs as a beautiful pink marble with dark green spots, and this, I believe, is unknown in any other part of the world.

The pink colour is due to peroxide of iron, and the dark green spots, which vary in quantity considerably in different specimens, are crystals of horn-blende. Three selected specimens accompanying this paper illustrate this variety. It takes a good polish, and two small polished pillars of it may be seen in the British Museum. There is difficulty, however, in procuring large slabs, as these generally contain some pieces of horn-blende, several inches in diameter and difficult to polish. It is a beautiful marble for inlaying in small pieces; its effect is well shown inlaid in a fine white marble mantelpiece in Inverary Castle. The white marble is too hard for ordinary working, but, as a facing-stone for exterior work, it would be almost imperishable.

The proportion of magnesian is remarkable.

The horn-blende in the pink, and the silica in the white, are variable.

	Pink.	White.
Calcium carbonate	70·85	50·70
Calcium sulphate	trace	—
Magnesium carbonate ..	2·35	37·92
Peroxide of iron	3·40	—
Calcium phosphate	—	0·80
Silica	—	10·18
Horn-blende	23·40	—
Water	—	0·40
	100·00	100·00

The peroxide of iron is scarcely soluble in dilute hydrochloric acid, which leaves most of the colouring matter.

* Read before the British Association, Liverpool Meeting, Section B

ON THE

EXISTENCE OF TWO SPECTRA PRODUCED BY CARBON INCANDESCENT AT THE SAME TEMPERATURE.*

By W. MARSHALL WATTS, D.Sc.,
Physical Science Master in the Manchester Grammar School.

ONE of the most interesting questions in the present stage of spectral analysis is the cause of the differences which are observed in the spectra of certain elements. The changes which can be brought about in the spectrum of a substance, by altering the conditions under which it is produced are of three kinds:—

(1). Simple addition of new lines—for example, the addition of the blue line to the lithium spectrum when the electric light is employed instead of the flame.

(2). Replacement of bands by groups of well-defined lines possessing generally nearly the same refrangibility —for example, the changes which take place in the spectra of strontium and calcium when they are produced by the electric spark instead of the flame.

(3). Total alteration of the spectrum—for example, the primary and secondary spectra of nitrogen, as described by Plücker and Hittorf.

There can be no doubt that changes of the first class are due simply to change of temperature; that is to say, at the higher temperature other atomic vibrations are set up simultaneously with the vibrations to which the lines of the lower temperature are due.

Changes of the second class are probably due to chemical decomposition. Thus, the broad bands of the calcium spectrum observed at the lower temperature of the flame are probably produced by the glowing vapour of calcium oxide; whereas, at the high temperature of the intense electric spark, the oxide is decomposed, and the metal vapour gives the fine lines which take the place of the bands.

Changes of the third class are more difficult of explanation.

They have been observed by Plücker and Hittorf, in the case of hydrogen, nitrogen, sulphur, selenium, phosphorus, and iodine; and by Wüllner, in the case of hydrogen, oxygen, and nitrogen. Wüllner has recently shown that hydrogen is capable of giving at least four different spectra. These different spectra of hydrogen are all obtained by the use of electricity; and both Plücker and Wüllner believe the changes to be caused by change of temperature. Thus Plücker says—"There is a certain number of elementary substances which, *when differently heated*, furnish two kinds of spectra not having any line or any band in common;" and Wüllner writes—"The difference of temperature must, in the case of hydrogen, be regarded as the sole cause of this phenomenon, for a decomposition into further elements is not to be thought of."

Carbon exhibits changes of spectrum, not only of the first and second classes but also of the third. I believe that I have obtained evidence that two of these spectra are produced at the same temperature.

Firstly, as to the evidence that each of these spectra is actually the spectrum of carbon itself, and not of any compound of carbon. The first of these spectra is shown to be that of carbon, inasmuch as it is common to olefiant gas, cyanogen, and carbonic oxide. It can be obtained from any one of these gases, by passing the electric spark through it, but is obtained most brilliantly by burning olefiant gas (or cyanogen) with oxygen in an oxyhydrogen jet. The second spectrum is shown to be that of carbon, inasmuch as it can be obtained alike from carbonic oxide, olefiant gas, or carbonic disulphide, and is most easily obtained from a Geissler's tube enclosing coal-gas.

The temperature of the first carbon spectrum is obtained with a certain degree of accuracy from the temperature of flames which give it.

* Read before the British Association, Liverpool Meeting, Section A.

The temperature of any flame can be calculated on the assumption that the whole heat of combustion is expended in raising the temperature of the products of combustion. The calculated temperature of a flame can never be less than the actual temperature, but is, in many cases, considerably too high, in consequence, principally, of dissociation; but the calculated temperatures are generally less in error when the combustion takes place in air, than when it takes place in oxygen. This will be seen from the following comparison of the results of calculation with the experimental results in those few cases in which trustworthy experimental results have been obtained:—

Combustion in Oxygen.

	Calculated flame temperature. °C.	Experimental. °C.
Hydrogen	6880	2844
Carbonic oxide	7067	3033

Combustion in Air.

	Calculated. °C.	Experimental. °C.
Hydrogen	2738	2024
Carbonic oxide	2996	1997
Cyanogen	3519	3297

The first carbon spectrum is obtained from the flame of olefiant gas in air, the calculated temperature of which is only 2619° C. No experimental determination of this temperature has been made. It is also obtained from the flame of a mixture of cyanogen and carbonic acid, the calculated temperature of which is 2016°; and can also be obtained from the inner blue cone of a Bunsen flame, the temperature of which is shown to be less than 2000° C., because, although it is capable of melting a fine gold wire (fusing-point 1300° C.), it refuses to melt the finest platinum wire (fusing-point 2000° C.).

The same spectrum (with the addition of some lines) is obtained from the flame of cyanogen in air, the temperature of which is determined, by calculation, to be 3519° C., and by experiment, 3297°. It is also obtained from the flame of cyanogen in oxygen, the calculated temperature of which is 10,557° C. We may therefore conclude that this spectrum is produced at any rate between the temperatures of 2000° C. and 3000° C.

The second carbon spectrum is obtained only by the use of electricity, and the difficulty of measuring the temperature of the ignited gas is great. I have sought to overcome this difficulty, by including sodium vapour with the gas in the Geissler's tube. We can hardly refuse to admit that the temperature of the ignited sodium vapour must be the same as that of the carbon compound; and the sodium spectrum contains certain lines, visible only at high temperatures, from which the temperature can be determined.

If the temperature to which the sodium vapour be heated be sufficiently high, the spectrum contains, besides the well-known double line, four other lines, each of them double; I denote these lines as Naβ, Naγ, Naδ, and Naε. In the Bunsen flame, the D lines only are obtained; but, if the temperature of the flame be increased, these other sodium lines come out one by one, and in the order given above. I find that Naβ becomes visible almost precisely at the temperature at which platinum melts—that is, 2000° C.; so that, if a bead of sodium carbonate be brought into any flame incapable of fusing platinum, only the D lines will be seen, but, if the flame be hot enough to fuse platinum, Naβ will also be visible.

For example—

The Bunsen flame gives the D lines only, and is incapable of fusing platinum.

The flame of coal-gas, fed by a jet of air mixed with a little oxygen, gave Naβ, but not Naγ. The flame fused platinum easily.

The flame of carbonic oxide in air (temperature, 1997° C.) gave only D; it is incapable of fusing platinum. Carbonic oxide fed by oxygen (temperature 3033° C.) gives Naβ and Naγ.

We conclude, therefore, that Naβ indicates a temperature of at least 2000° C., and that Naγ comes out about 3000° C.

If now the discharge of an induction coil be passed through a Geissler's tube containing carbonic oxide and sodium, the carbon spectrum No. 2 is obtained; and if the sodium be volatilised, the sodium lines come out one by one as the tube gets hot, and the carbon lines are seen simultaneously with Naβ, and (at first) without Naγ. Hence we conclude that this second spectrum is also produced by carbon between the temperatures of 2000° and 3000° C. I do not presume to attempt an explanation of this difference of vibration at the same temperature. In view of the fact that the second spectrum is produced only by means of electricity, the question suggests itself—Whether the atomic vibrations of the gas produced by the electric discharge are different *in kind* from the vibrations which we measure as temperature? Or, if a very crude hypothesis may be allowed, I would suggest that identity of temperature means identity of *molecular* vibration, but that the light emitted is caused by the inter-molecular vibration of *atoms*. If this hypothesis be admitted, a test experiment suggests itself. If, by increase of temperature, the velocity of the molecules of a gas be increased, the refrangibility of the light, caused by the vibrations of their constituent atoms, ought to be slightly increased in the motion of the molecule towards the observer, and slightly diminished in the motion of the molecule from the observer; so that a line ought to become broader when the temperature of the source of light is increased.

If, then, the slit of a spectroscope be partly illuminated with sodium-light from a flame of low temperature, and partly from the intense electric spark, the D lines should exhibit a less interval in the latter case than in the former. A rough calculation shows that, if the temperature of the flame be 2000° C., and of the spark 10,000° C., the interval between the two sodium lines ought to be diminished by about one-twentieth. I have endeavoured to detect this difference, but the dispersive power of the spectroscope at my disposal (a three-prism instrument, kindly lent by my friend Mr. S. Okell) was not great enough.

ANALYSIS OF SOME HITHERTO UNDETERMINED AMERICAN MINERALS.

By Professor LEEDS.

I.

A GREENISH-WHITE, translucent, compact mineral, from Van Arsdale's quarry, near Attleboro', Bucks County, Pennsylvania, previously regarded as Ekebergite.

Percentage Composition.

Sp. gr., 2·71.

SiO_2	47·47
Al_2O_3	27·51
Fe_2O_3	trace
MgO	1·20
CaO	17·59
Na_2O	3·05
K_2O	1·40
H_2O	1·48
	99·70

The atomic ratio, obtained by multiplying the quotients of these per cents by the atomic weights into the quantivalences of the radicals, is—

Si	0·790 × 4 = 3·16	3·16 or 12.
$[Al_2]$	0·270 × 6 = 1·62	1·62 or 6.
Mg	0·030 × 2 = 0·06	—
Ca	0·310 × 2 = 0·62	—
Na_2	0·050 × 2 = 0·10	—
K_2	0·015 × 2 = 0·03	—
H_2	0·080 × 2 = 0·16	0·97 or 4.

Excluding the percentage of water, as has been done hitherto in the computation of the formulæ of these and analogous silicates, we have for the atomic ratio, 1 : 2 : 4. If we deduct the amount of Si corresponding to the H_2, regarding the matter as existing in the mineral in the form of hydrate of silicic acid, we again have the ratio 4 : 6 : 12, and the formula $(Ca,Na_2)_2[Al_2]Si_3O_{10}$. And the mineral is Scapolite.

The same mineral is found in the locality mentioned above, in imperfect crystals with rough faces. It is associated with pyroxene, graphite, sphene, and phlogopite in granular limestone.

II.

A variety of orthoclase, which is described by I. Lea* as being of a dull bluish-green colour, and semi-transparent, with very minute crystalline hexagonal plates disseminated through the mass, and giving out very bright reflections. These plates may be seen with the naked eye. The name proposed for this variety was *cassinite*. It is found in a ploughed field on a serpentine ridge known as Blue Hill, in Upper Providence Township, Delaware County, four miles north-west of Media.

Percentage Composition.

SiO_2	64·20
Al_2O_3	19·69
Fe_2O_3	0·69
CaO	2·27
MgO	0·15
K_2O	9·59
Na_2O	3·43
H_2O	0·27
	100·29

Its formula is $(K_2,Na_2)[Al_2]Si_6,O_{16}$, the same as common orthoclase.

III.

A yellowish white mineral, with rhombohedral cleavage and vitreous lustre, occurring imbedded in steatite. It is associated with a ferruginous dolomite, and often intermixed with it: becomes brown on exposure. It is found at the soapstone quarry on the north-east bank of the Schuylkill river, on the line between Philadelphia and Montgomery County.

Percentage Composition as given by the Mean of Two Analyses.

MgO	38·43
FeO	10·39
CaO	3·29
CO_2	47·96
	100·07

It is to be regarded, therefore, as a ferriferous magnesite, or breunerite.

My thanks are due to Mr. Theodore D. Rand, who obtained the specimens of these three minerals at the localities, and kindly presented them to me for analysis.—*Journal of the Franklin Institute.*

ON THE NUMBER OF ISOMERIC BODIES.†

By O. LOEW.

THE rational formulæ of organic combinations differ so much among themselves at the present time, and are occasionally so incomprehensible, and on no reasonable ground, that it is of the greatest importance to organic chemistry when a man of Kolbe's learning undertakes to reconstruct the rational formulæ on as natural a basis as possible, and in correspondence with the true characters of bodies.

* *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1866.

† Communicated by the Author.

The chief feature in Kolbe's theory is substitution, whereas other chemists, under the lead of Kekulé, follow that of agglomeration, and of the so-called binding and linking of the atoms.

Taking an unprejudiced view of Kolbe's formulæ, it will be observed that they express all the decompositions which the body under consideration undergoes by means of different reagents, and that no other formulæ can explain the nature and the number of the isomeries, which are at times very numerous.

Considering, by way of example, the so-called ether radicals—

methyl = $\left.\begin{matrix}H\\H\\H\end{matrix}\right\}$ C and ethyl $\left.\begin{matrix}(H_3C)\\H\\H\end{matrix}\right\}$ C have no mono-carbolic isomeries; but when we take the next highest radical, "propyl," we find two isomeries, which are represented by the following rational formulæ—

(1.) $\left.\begin{matrix}H_3C\\H\\H\end{matrix}\right\}$ C $\left.\begin{matrix}\\\\H\\H\end{matrix}\right\}$ C (2.) $\left.\begin{matrix}H_3C\\H_3C\\H\end{matrix}\right\}$ C

No. 1 is the true homologue of methyl; No. 2 is the so-called isopropyl, a secondary radical, yielding no respective aldehyd.

Passing now to butyl, C_4H_9, when we define it is a derivative of methyl, in which hydrogen is substituted for methyl, ethyl, or propyl, we find already four isomeries.

(1.) $\left.\begin{matrix}H_3C\\H_2\end{matrix}\right\}$ C $\left.\begin{matrix}\\H_2\end{matrix}\right\}$ C $\left.\begin{matrix}\\\\H_2\end{matrix}\right\}$ C (2.) $\left.\begin{matrix}H_3C\\H_3C\\H\end{matrix}\right\}$ C $\left.\begin{matrix}\\\\H_2\end{matrix}\right\}$ C

True homologue. Second primary radical.

(3.) $\left.\begin{matrix}H_3C\\H_2\\H_3C\\H\end{matrix}\right\}$ C $\left.\begin{matrix}\\\\\\\end{matrix}\right\}$ C (4.) $\left.\begin{matrix}H_3C\\H_3C\\H_3C\end{matrix}\right\}$ C

Secondary radical. Tertiary radical.

The next highest radical is amyl, C_5H_{11}, in which we find already eight isomeric *monocarbolic* radicals, namely, four primary, three secondary, and one tertiary. Adding all these monocarbolic and bicarbolic radicals, which are isomeric to amyl, we obtain a much higher number (*vide* Table).

The monocarbolic radicals of the formula of capryl show seventeen isomeries. In this manner we obtain:

for septyl, C_7H_{15} = 39 isomeries,
for octyl, C_8H_{17} = 89 ,,
for nonyl, C_9H_{19} = 221 ,,
for decyl, $C_{10}H_{21}$ = 619 ,,
&c.

The general rule from capryl up is expressed thus: that for a body of the general formula CxH_{2x+1}, there exist more than $2^{(x-2)}$ isomeric *monocarbolic* combinations, and less than $2^{(x-1)}$. If we apply this law upon stearic acid = $(C_{17}H_{35})[CO]OH$, we find there exist more than 2^{15} = more than 131072 isomeries.

The different stearic acids are probably very difficult to distinguish, even by means of polarised light, or by the melting point, but we cannot deny the possibility that at some future time we may be able to construct more delicate and subtle instruments to separate bodies, which, although only isomeric, do not show a striking chemical difference. An example illustrating these remarks very satisfactorily is shown by the oil of turpentine, $C_{10}H_{16}$.

We know a great number of hydrocarbons which have this formula—for instance, oil of lemons, of cubebs, of juniper, &c. The great difference in the smell leads us to the conclusion that there must be a difference in their chemical constitution. There are several other hydrocarbons of the formula $C_{10}H_{16}$ which show no difference in smell, although they differ from oil of turpentine in the power of turning the *plane of polarisation*; which is the fact that shows us that these bodies are not identical, but are isomeric.

Kolbe considers the oil of turpentine as a dicarbol. Dicarbols are hydrocarbons in which two atoms of the same hydrocarbon are connected by a diatomic radical. According to Kolbe, benzol is a tricarbol.

Kolbe,* in his theory, points out the analogy between tricarbols and triamins, the latter of which are known as bodies of a well-defined constitution. The ingenious theory of Kolbe has, consequently, a true and positive foundation.

We will now calculate how many isomeries exist in the derivatives of ammonia; in a manner similar to the above, we find for—

(1.) Ethylamine, 2 isomeries. (1 primary, 1 secondary.)
(2.) Propylamine, 4 ,, (2 prim., 1 sec., 1 ter.)
(3.) Butylamine, 8 ,, (4 prim., 3 sec., 1 ter.)
(4.) Amylamine, 17 ,, (8 prim., 6 sec., 3 ter.)
(5.) Caprylamine, 39 ,, (17 prim., 15 sec., 7 ter.)

These numbers are only calculated for the *monocarbols* contained in these bases. The general law is thus:—

For a base of the general formula—

$$\left.\begin{matrix}C_xH_{(2x+1)}\\H_2\end{matrix}\right\}N,$$

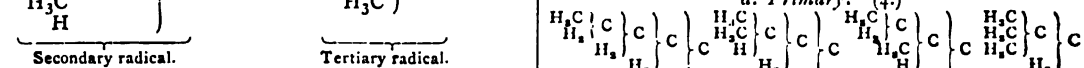
there exist more than $2^{(x-1)}$, and less than 2^x isomeries.

If now we wish to see how many isomeries exist in the non-saturated hydrocarbons, in the oxy-amido-nitro products, we would be obliged to calculate an immense number of bodies. This example shows sufficiently how fruitful Kolbe's theory is, how the numerous isomeries may be explained, and what a prospect Kolbe opens for the existence of an immense number of bodies.

Isomeries of Amyl. C_5H_{11}.

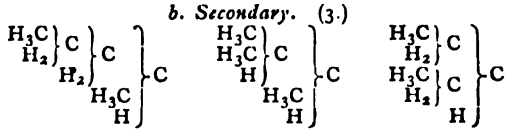
I. Monocarbolic Radicals.

a. Primary. (4.)

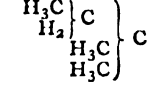


True Homologon to Methyl.

b. Secondary. (3.)



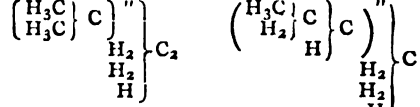
c. Tertiary. (1.)



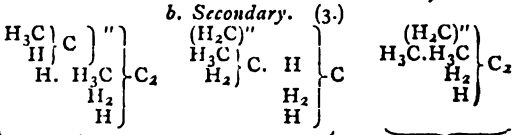
Isomeries of Amyl. C_5H_{11}.

II. Dicarbolic Radicals.

a. Primary. (2.)



b. Secondary. (3.)



Secondary dicarbol of the first order. Secondary dicarbol of the second order.

* I take this opportunity of calling attention to Kolbe's interesting work, "Ueber die Constitution der Kohlenwasserstoffe."

III. Tricarbolic Radicals.

$$(H_3C.C)'''\left\{\begin{matrix}H_3\\H_3\\H_2\end{matrix}\right\}C_3 \qquad (HC)'''\left\{\begin{matrix}H_2.H_3C\\H_3\\H_2\end{matrix}\right\}C_3$$

IV. Tetracarbolic Radical.

$$C''''\left\{\begin{matrix}H_4\\H_4\\H_3\end{matrix}\right\}C_4$$

NOTE ON THE SPECTRA OF ERBIA AND SOME OTHER EARTHS.*

By WILLIAM HUGGINS, LL.D., F.R.S.

BAHR and Bunsen have shown† that erbia, rendered incandescent in a Bunsen's gas-flame, gives a spectrum of bright lines in addition to a brilliant continuous spectrum. As they were unable to discover the bright lines in the flame beyond the limits of the solid erbia, they suggest that the light which is dispersed by the prism into bright lines is emitted by the solid erbia, which substance therefore appears to stand alone, as a remarkable exception, among solid bodies. Bahr and Bunsen found the spectrum of bright lines to coincide very nearly with the absorption spectrum of some compounds of erbium.

A few weeks since, when in Ireland, I made the observation that the spectrum of the ordinary lime-light contains bright lines.‡ Dr. Emerson Reynolds, Director of the Laboratory of the Royal Dublin Society, kindly undertook to make experiments to ascertain from the position of the lines if they were due to the cylinder of lime, or to impurities contained in it.

Upon my return to town I made the following experiments; shortly after commencing them I received from Dr. Reynolds the account of his experiments, which, with his permission, I have added to this note.

Erbia.—A few months since I received, through the kindness of Dr. Roscoe, F.R.S., a few grains of nitrate of erbia, which he had procured from a trustworthy source. I followed Bunsen's method of placing it with syrupy phosphoric acid upon a platinum wire. The erbia, obtained by this method in a finely divided state, was then submitted to the heat of the oxyhydrogen blowpipe.

In all the experiments described in this paper hydrogen alone was first turned on, and the effect of the heat of the flame on the substance under examination observed with the spectroscope. Oxygen was then admitted slowly, and the effect of the increased heat carefully noted.

With the flame of hydrogen alone, the lines representd in the map which accompanies Bahr and Bunsen's paper were seen, but the lines were more distinct when a small proportion of oxygen was admitted. With the full proportion of oxygen, the light from the glowing erbia was more intense, but the lines were not so well seen. Even with the intense heat of the oxyhydrogen flame I was unable to trace the lines beyond the limits of the solid erbia, though the line of sodium could be seen for some distance from the erbia. I found, however, that the lines appeared more distinct, in consequence, probably, of their being brighter relatively to the parts of the continuous spectrum where they occur, when the slit was directed from the side upon the gas immediately in front of the glowing part of the erbia.

The spectrum of bright lines obtained by means of the oxyhydrogen flame agreed more completely with the absorption spectrum represented by Bahr and Bunsen (No 2 in their diagram) than the spectrum of bright lines figured by those observers (No. 3). The most important differences occurred in the band in the red, which showed two points of greatest brightness, thus forming a double line with a little outstanding light, and the line at the green at 65 of the scale, which was double, precisely as the corresponding absorption-line is represented in spectrum No. 2 of the diagram.

Lime.—The experiments were made with the cylinders of lime prepared for use with the oxyhydrogen blowpipe, and also with pieces of pure caustic lime, but there was no sensible difference presented in the spectroscope.

The bright lines consisted of a double line in the green, and several bands in the orange and red, which were found to form a spectrum identical with that which is produced when chloride of calcium is heated in the flame of a Bunsen's burner.

When the spectroscope was directed to a point in the flame a little above the incandescent portion of the lime, the lines appeared beyond the bright continuous spectrum, showing that they are not produced by the white-hot solid lime, but by the luminous vapour into which a portion of the lime has been converted by the heat of the flame.

Magnesia.—The commercial heavy oxide of magnesium was made into a paste with distilled water, and formed into a small pellet upon the end of a platinum wire. The pellet of magnesia was slowly dried, and then placed in the oxyhydrogen flame. I was surprised to see a spectrum of bright lines precisely similar to that which is produced by lime. Chloride of magnesium, when introduced into the Bunsen flame, gave a similar spectrum. I record these results as the oxide and chloride were those sold as pure. I found afterwards that a very small trace of lime may be detected in magnesia by means of the oxyhydrogen flame.

I then took metallic magnesium, which I had found by the spectroscope to be nearly pure, and formed from it magnesia and chloride of magnesium.

When this magnesia, formed into a small ball upon a wire, was subjected to the oxyhydrogen flame, two bright bands were seen in the green. One of these was found to be coincident with the triple line of Fraunhofer's *b*, which distinguishes magnesium, and the other with a group of bright lines which is seen between *b* and F, nearly in the position of the brightest double line of nitrogen, when metallic magnesium is burnt in air.

The chloride formed from magnesium, when introduced into the Bunsen flame, gave the same bands, but the more refrangible band was exceedingly faint.

When an induction-spark was taken from a wire covered with cotton-wool soaked with a solution of the chloride, the lines at *b* and the more refrangible group were seen. If the heating-power of the spark be increased by the introduction of a Leyden jar, the band between *b* and F becomes scarcely distinguishable, while the lines peculiar to metallic magnesium are much more intense. When a spark is taken between electrodes of the same specimen of magnesium from which the chloride was formed, no trace of this band was detected.

Baryta.—When pure caustic baryta is subjected to the heat of the oxyhydrogen flame, a brilliant spectrum is seen identical with the well-known spectrum which presents itself when chloride of barium is heated in the Bunsen flame. Baryta furnishes a larger quantity of vapour than lime and magnesia, and therefore the lines could be traced to a greater distance from the solid baryta.

Strontia.—Pure strontia was fused into a large bead upon a platinum wire. When this bead was heated by the oxyhydrogen flame, the same spectrum of bright lines presented itself as is seen when chloride of strontium is placed in the flame of a Bunsen's burner.

Zirconia.—One of the small pellets of zirconia prepared in France for use with the oxyhydrogen blowpipe was found to give no trace of bright lines. This great fixity of zirconia as compared with lime is in agreement with the inalterability of the substance under the action of the oxyhydrogen flame.

* From the *Proceedings of the Royal Society*, No. 122, 1870.

† Liebig's *Annalen*, Bd. lxi. (1866) S. 1.

‡ Dr. W. Allen Miller informs me that in 1845 he noticed a bright line in the spectrum of the diffused light of the oxyhydrogen jet reflected from a sheet of paper.

Alumina.—Pure alumina treated in the same way as the magnesia gave a continuous spectrum only, without any trace of bright lines.

Glucina.—Glucina gave a bright line in the red, which I found to be due to potassium. Glucina, therefore, appears not to form vapour of any kind under the heat of the oxyhydrogen blowpipe.

Titanic acid gave a continuous spectrum without lines.

Oxide of uranium a continuous spectrum without lines.

Tungstic acid a continuous spectrum without bright lines.

Molybdic acid a continuous spectrum without bright lines.

Silica (precipitated) a continuous spectrum without bright lines.

Oxide of cerium a continuous spectrum without bright lines.

The question presents itself as to the nature of the vapour to which the bright lines are due in the case of the earths, lime, magnesia, strontia, and baryta. Is it the oxide volatilised? or is it the vapour of the metal reduced by the heat in the presence of the hydrogen of the flame? The experiments show that the luminous vapour is the same as that produced by the exposure of the chlorides of the metals to the heat of the Bunsen gas-flame. The character common to these spectra of bands of some width, in most cases gradually shading off at the sides, is different from that which distinguishes the spectra of these metals when used as electrodes in the metallic state.*

Roscoe and Clifton have investigated the different spectra presented by calcium, strontium, and barium, and they "suggest that at the lower temperature of the flame or weak spark, the spectrum observed is produced by the glowing vapour of some compound, probably the oxide, of the difficultly reducible metal; whereas, at the enormously high temperature of the intense electric spark these compounds are split up, and thus the true spectrum of the metal is obtained. In none of the spectra of the more reducible alkaline metals (potassium, sodium, lithium) can any deviation or disappearance of the maxima of light be noticed on change of temperature."†

As the experiments recorded in this paper show that the same spectra are produced by the exposure of the oxides to the oxyhydrogen flame, Roscoe and Clifton's suggestion, that these spectra are due to the volatilisation of the compound of the metal with oxygen, is doubtless correct.

The similar character of the spectrum of the bright lines seen when erbia is rendered incandescent would seem to suggest whether this earth may not be volatile in a small degree, as is the case with lime, magnesia, and some other earths. The peculiarity, however, of the bright lines of erbia, observed by Bahr and Bunsen, that they could not be seen in the flame beyond the limits of the solid erbia, deserves attention. My own experiments to detect the lines in the Bunsen gas-flame, even when a very thin wire was used, so as to allow the erbia to attain nearly the heat of the flame, were unsuccessful. The bright line in the green appears, indeed, to rise to a very small extent beyond the continuous spectrum, but I was unable to assure myself whether this appearance might not be an effect of irradiation.

It is, perhaps, worthy of remark that the chlorides of sodium, potassium, lithium, cæsium, and rubidium, give spectra of defined lines, which are not altered in character by the introduction of a Leyden jar, and which, in the case of sodium, potassium, and lithium, we know to resemble the spectra obtained when electrodes of the metals are used. Now, all these metals belong to the monad group; it appeared, therefore, interesting to observe the behaviour of the other metal belonging to this group.

Chloride of silver when introduced into the Bunsen flame gave no lines. The chloride was then mixed with alumina, which had been found to give a continuous spectrum only, and exposed to the oxyhydrogen flame, but no lines were visible. When, however, the moistened chloride was placed on cotton and subjected to the induction-spark without a jar, the true metallic spectrum was seen, as when silver electrodes are used.

The behaviour of silver, therefore, is similar to that of the other metals of the monad group. Now, the difference in basic relations which is known to exist between the oxides of the monatomic and polyatomic metals would be in accordance with the distinction which the spectroscope shows to exist in the behaviour of the chlorides; the chlorides of the polyatomic metals would be more likely to split up in the presence of water into oxides and hydrochloric acid.

In the case of some of the oxides and chlorides, one or more of the lines appeared to agree with corresponding lines in the metallic spectra; it may be, therefore, that, under some circumstances, as in the case of magnesium burning in air, the metallic vapour and the volatilised oxide may be simultaneously present.

Dr. Reynolds's Experiments.

"After you observed the occurrence of two bright lines in the spectrum of the light emitted by incandescent lime, you recollect we identified these as belonging to calcium. At the time we supposed that these lines were produced by the ignition of the vapour of some volatile calcium compound probably present as an impurity in the sample of limes used in the experiments. If this explanation was found to be true for lime, the bright lines seen in the spectrum of erbia might possibly be accounted for in a similar manner. In order to examine the matter fully, I arranged the experiments described below.

"I selected two oxides for comparison with erbia, viz., lime and magnesia. As it seemed desirable to prepare these oxides in precisely the same manner as the erbia, some calcium and magnesium nitrates were made chemically pure to ordinary tests, and then used in the preparation of the respective oxides.

"The oxyhydrogen flame was employed as the chief source of heat. The hydrogen was made from zinc and sulphuric acid in the usual way, and the oxygen from potassium chlorate. As both gases are certain to be contaminated with traces of acids, I took the precaution of passing each gas through a long tube filled with fragments of solid potassium hydrate. If this plan were not adopted, the traces of acid which would find their way into the hydrogen or oxyhydrogen flame might produce volatile compounds with the earths, and so lead to mistakes.

"1. *Experiments with Magnesia.*—A loop of stout platinum wire was moistened with syrupy phosphoric acid, and some magnesium nitrate made to adhere. The nitrate was then heated in the hydrogen flame, and a residue of magnesia obtained. No lines were observed in the spectrum of the light emitted by the incandescent earth, and when the latter was intensely heated in the oxyhydrogen jet only a continuous spectrum was seen.*

"2. *Experiments with Lime.*—A platinum wire, of the same thickness as the last, was moistened with the phosphoric acid, some calcium nitrate was then taken up in the loop, and heated in the hydrogen flame until a residue of lime was obtained. At the outset, the calcium-spectrum was observed, but the light speedily gave only a continuous spectrum. The lime and loop of wire were kept well enveloped in the hydrogen flame for nearly half an hour, in order to ensure the complete decomposition of the nitrate. During this time, no lines could be detected on the background of the continuous spectrum, or in the spectrum of

* For the spectra of metallic strontium, barium, and calcium, see *Phil. Trans.* 1864, p. 148, and Plates 1 and 2. Both forms of the spectra of these substances are represented by Thalen in his "Spektralanalys."

† Roscoe's "Spectrum Analysis," p. 175, and *Proc. Lit. and Phil. Soc. Manchester*, April 1, 1862. See also A. Mitscherlich, "Ueber der Spectren der Verbindungen," S. 10.

* "Since writing the above, I have succeeded in observing the bright lines described by Mr. Huggins as occurring in the spectrum of the flame surrounding the incandescent magnesia. In the earlier experiments I probably admitted too much oxygen to the mixed gas-flame in the first instance."

the flame surrounding the lime. More hydrogen was now turned on, and oxygen slowly admitted, the light being examined with the spectroscope during the time. When the proportion of oxygen had reached a certain point, faint traces of the two brightest Ca lines appeared on the bright background, and the intensity of these lines increased with the amount of oxygen admitted up to a definite extent. When a certain proportion of oxygen was exceeded, the lines became less distinct. The best results were obtained when the hydrogen was decidedly in excess of the oxygen in the flame—that is to say, more than in the proportion of 2 : 1.

"When the slit of the spectroscope was pointed in such a way that only the light from the flame surrounding the incandescent lime entered the instrument, all the Ca lines and bands were observed with great ease without a continuous spectrum. On looking at the mantle of flame with the naked eye, it was easy to perceive a reddish tinge. I next maintained the small fragment of lime at the highest temperature its supporting wire was capable of resisting for *three hours*; at the end of this time, the Ca lines were as strongly marked as before, and the lime on the wire had very appreciably diminished in amount. The same results were obtained when no phosphoric acid was employed to attach the calcium nitrate to the wire in the first instance.

"Again, a piece of well-burned quicklime, of very small size, was heated alone on a platinum wire for more than an hour, and the bright Ca lines were seen during the whole time.

"From the results of these experiments, we must draw the conclusions—(1) that, when lime is sufficiently heated, the light which it emits is derived in part from the incandescent solid, and partly from ignited vapour; (2) that lime is either volatile *as such*, or that in the first instance it suffers reduction by the excess of hydrogen in the flame, the luminous vapour of calcium then giving its own peculiar spectrum.

"3. *Experiments with Erbia.*—The specimen of erbium nitrate which you kindly gave me was attached to a platinum loop with syrupy phosphoric acid, as usual, and decomposition of the salt effected in the plain hydrogen flame. After heating for a short time in this way, the chief green line of erbia became visible, but seen upon the continuous spectrum. Oxygen was now turned slowly into the flame. As the temperature rose, two of the other bright lines of the earth were seen. The best observations were made when the oxyhydrogen flame had hydrogen in excess, and the erbia was kept in such a position that it was very strongly ignited. The erbia lines were most distinctly seen when the slit of the spectroscope took in the light from the extreme edge of the incandescent solid. When the bright lines were best observed, the continuous spectrum was relatively faint. Again, when the slit was made to cut the edge of the ignited bead of the earth, the strong green line of erbia was seen to extend to a very small, but appreciable, distance above or below (as the case might be) the continuous spectrum. I could only observe this for the strong line. I failed to get any trace of lines in the spectrum of the flame beyond the incandescent erbia.

"The erbia was next heated in the oxyhydrogen flame to the maximum temperature that the wire would bear for *three and a half hours*, but the green line was seen to be just as strongly marked at the end as at the beginning of the experiment. The bulk of the erbia was so much reduced by this treatment, that I have now scarcely a trace left.

"From the results of these experiments, I think we must conclude—(1) that the light emitted by incandescent erbia is derived chiefly from the ignited solid, but that the bright lines observed in its spectrum have, as their source, a luminous vapour of extremely low tension at even the highest temperature of the oxyhydrogen flame; (2) that this interrupted spectrum belongs either to erbium or to its oxide.

"If these conclusions are true, it follows that erbia is not an exception to the ordinary law.

"It would appear that, in these experiments, three substances have been employed, varying in their degree of volatility. At the temperature of the oxyhydrogen flame, magnesia appears to be less volatile than lime; but I am in doubt what relative volatility to assign to erbia, since its spectrum of bright lines can be seen when the earth is heated in the plain hydrogen flame, and yet at the much higher temperature of the oxyhydrogen jet the volume of luminous vapour does not appear to materially increase.

"Finally, we have yet to learn whether or not in all these cases reduction of the oxide precedes volatilisation; if reduction takes place, the luminous vapour must be that of the metal. The settlement of this question would no doubt be very difficult. But I rather incline to the view that the vapour whose spectrum is obtained on igniting these earths is that of the metal; for I find that the bright lines are most easily observed when hydrogen is present in excess in the oxyhydrogen flame. Moreover, the actual amount of matter volatilised on very prolonged heating is really very small, and this circumstance appears to favour the view that a slow surface-reduction is in progress."

OBITUARY.

WILLIAM ALLEN MILLER.

PROFESSOR MILLER, of King's College, London, died at Liverpool, of apoplexy, on Friday, the 30th of September. He left London on the 13th of September for the British Association, and was taken ill on the journey.

William Allen Miller was born at Ipswich, in Suffolk, on the 17th of December, 1817. He was carefully educated by his mother, who seems to have imparted to her son much of her own quiet, sagacious nature. He spent one year in Merchant Taylors' School, and two years in a school belonging to the Society of Friends, at Ackworth, in Yorkshire, where lectures on elementary chemistry were delivered, and from which young Miller imbibed a taste for that science. He was also much impressed with the phenomena of the stars as seen through a telescope which one of the masters used to exhibit to the pupils. These early impressions bore fruit in the chemistry of the stars, with which his name is now permanently associated. His training at Ackworth imparted to his manner that quiet simplicity which marks the members of the Society of Friends. At the age of fifteen he was apprenticed to his uncle, who was surgeon to the General Hospital at Birmingham. After five years he entered the Medical Department of King's College, where his knowledge of chemistry attracted the attention of Professor Daniell, who during the illness of the laboratory assistant engaged his services. This was the turning point in his career. In 1839 he gained the Warneford Prize for the encouragement of theological studies among medical students. In 1840 he visited Germany, and passed some time in Liebig's laboratory at Giessen. In the same year he was appointed to the post of Demonstrator in the Laboratory of King's College. In 1841 he became Assistant Lecturer to Professor Daniell, and also took his degree of M.D. in the University of London. He also assisted Professor Daniell in various scientific enquiries, and conducted the experiments on the electrolysis of saline compounds, his name being associated with that of Daniell in the paper that appeared in the *Phil. Trans.* for 1844. In the following year he became a Fellow of the Royal Society, and on the death of Professor Daniell succeeded to the vacant chair. During a quarter of a century, he continued to lecture with unceasing activity, and to take part in the management of the College, every one, from the Principal

and Professors to the youngest student, being anxious to obtain his advice and assistance. It was impossible to come into contact with him without feeling oneself in the presence of a man of pure nature, of spotless integrity, of sound and sagacious judgment, and of true gentlemanly feeling. His loss will be deeply felt, especially in King's College; in the Royal Society, of which he was Treasurer and Vice-President; in the Mint, and the Bank of England, where he was one of the Assayers. He will be missed in the Courts of Law, where his clear perception of patented processes and his strong sense of justice made him respected alike by Judge and Counsel. He will be missed by the manufacturers who sought his advice; but most of all he will be missed by the few friends who had his confidence. There is no man since Faraday whose loss will be so much mourned and regretted. He was buried at Norwood Cemetery on Wednesday last by the side of his wife, whom he survived one year. He died on the anniversary of her burial.

Prof. Miller bore his honours lightly; but perhaps it would be wrong to omit tnat he received the degree of LL.D. at the University of Edinburgh; that of D.C.L. at the University of Oxford, in June, 1868; and that of LL.D. at the University of Cambridge, in May, 1869, after giving the Reade Lecture. He also received the gold medal of the Astronomical Society, in conjunction with his friend and fellow worker, Mr. Huggins.

C. T.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

[In consequence of the war on the Continent, several of the foreign journals have failed to reach us; we shall, however, give abstracts of them as soon as they are received.]

Annalen der Chemie und Pharmacie, August, 1870.

This number contains the following original papers and memoirs:—

The Iva (Achillea Moschata).—Dr. A. von Planta-Reichenau.—The subject of this memoir is a celebrated plant, a native of the Swiss mountains, and for centuries has been in high repute as a medicinal agent. The author first refers briefly to some historical facts bearing upon the Iva and its use; and then states that, as nothing is yet known in reference to the chemistry of this substance, he, having an excellent opportunity to procure the herb, undertook the exhaustive research of the same. The lengthy memoir treats on essential oil of Iva, which, in the crude state, has a bluish green colour, a taste somewhat akin to oil of peppermint, while its smell is not disagreeable; its sp. gr., at 15°, is 0·9346; formula, $C_{28}H_{40}O$. The pure oil, boiling at between 170° and 210°, is a pale yellow-coloured fluid, exhibiting a peculiar strong ethereal smell; its taste is bitter, but, at the same time, like peppermint; the formula of the pure substance is $C_{24}H_{40}O_3$. Ivain, an oleo-resinous bitter matter, readily soluble in water and alcohol, is the hydrate of the Iva oil. Stearic acid is also present in the herb, and, moreover, three other substances, which the author has called achilleine, moschatine and achilletine, the latter being the product of the decomposition of achilleine. This latter is a peculiar alkaloid, containing $C_{20}H_{28}N_2O_{12}$.

Analysis of the Water of the Thermal Spring of Ragaz-Pfäfers.—Dr. A. von Planta-Reichenau.—The spring alluded to is situated in the Canton St. Gall, Switzerland. The taste of this water is like that of warm distilled water; its temperature, at the source, 37·5°; sp. gr., 1·0003. 10,000 parts of this water contain—Sulphate of potassa, 0·0746; sulphate of soda, 0·3294; chloride of lithium, 0·0020; chloride of sodium, 0·4934; iodide of sodium, 0·0001; bromide of sodium, 0·0002; borate of soda, 0·0038; carbonate of soda, 0·0613 (all carbonates have been calculated as monocarbonates); carbonate of lime, 1·3064; carbonate of magnesia, 0·5306; carbonate of strontia, 0·0152; carbonate of baryta, 0·0064; carbonate of protoxide of iron, 0·0172; phosphate of alumina, 0·0091; silica, 0·1408; traces of rubidium, cæsium, and thallium—Total of solid constituents, 2·9905. 10,000 c.c. of the water contain 119·2 c.c. of gas, consisting, in 100 parts, of—Carbonic acid, 16·43; oxygen, 24·24; nitrogen, 59·33.

Non-Existence of Chlor-Cyanhydrogen.—A. Naumann and E. Vogt.—This paper treats, at length, on the question, whether the chlor-cyanhydrogen, 2CyCl.CyH, can and does exist; and the conclusion the authors have come to, after a lengthy series of experiments, is, that it does not exist as a definite chemical compound.

Uroxanic Acid, and the Chemical Constitution of Uric Acid.—Dr. A. Strecker.

Behaviour of Chloride of Platinum towards Lime and Baryta-Water.—E. Johannsen.—This lengthy essay treats on a series of binary compounds which lime and baryta form with chloride of platinum. The paper, an excellent monograph on this subject, contains the results of a great number of analyses. The main result is that platinum has a greater affinity for chlorine than calcium and barium.

Formation of Chloro-Maleic Acid from Benzol.—Dr. L. Carius.—The author describes, first, a series of reactions of the hydrate of chloric acid upon benzol, resulting in the formation of various bodies, among which monochlor-maleic acid, $C_4H_3ClO_4$, a crystalline substance, readily soluble in water, alcohol, and ether; fusing at 171°; boiling at 180°. This acid is bibasic. The author describes, at great length, several of its salts, some of which crystallise very readily.

Two Metallic Derivatives of Glycerine.—Dr. P. Schotländer.—This lengthy monograph treats on the preparation and constitution of some compounds of glycerine, or, rather, the radical glyceryl, C_3H_5, with manganese, sodium, potassium, and strontium.

American Journal of Pharmacy, September, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Most Delicate Colour-Test for the Detection of Strychnia.—W. T. Wenzell.—After referring at some length to the great variation of the precise limit of the sensibility of the colour tests usually applied for the detection of strychnia, and also discussing the best form of using and manner of applying these tests, the author says—In testing for minute portions of the alkaloid, it is a desideratum to use a reagent the proportionate relations and superior sensitiveness of which will admit of the successful demonstration of traces of the poison. In experimenting towards that end, I have found that a solution of 1 grain of permanganate of potassa in 2000 grms. of sulphuric acid is, *par excellence*, the test for that purpose. The author gives, further, a lengthy account of a series of experiments, instituted with various reagents, for the purpose of testing the delicacy of each of these for the detection of strychnia, the result being that the limit of positive recognition by the bichromate of potassa and sulphuric acid test may be placed at 1-100,000th, that of the chromic acid test at 1-600,000th, and that of the permanganate at 1-900,000th. As regards the use of the permanganate, the author distinctly states that the honour of its discovery belongs to Dr. Wm. A. Guy, of London.

Phosphate of Lime in Acetic Acid.—W. H. Bruckner.—The author relates that, while engaged in analysing a sample of Charleston guano, he had occasion to use acetic acid, and, finding the results of his analysis unsatisfactory, and differing too much, he found, on testing the acetic acid (sold as chemically pure), to contain a not inconsiderable quantity of phosphate of lime; but the percentage of this impurity present was not determined, neither is any clue given to the way in which this material came to be present in the acid.

Production of Iodine and Bromine.—W. H. Chandler.—After referring at length to the various sources from which the two haloids alluded to are derived, the author mentions a few instances of the quantity of the elements above named present in some of the waters of saline springs in the United States, where iodine and bromine were first discovered in 1830—the former body in the Saratoga spring-waters, and the latter in the salines of Onondaga. The quantity of bromine in the Saratoga spring-waters, as determined by Professor Chandler, reaches 3·63 grms. per gallon; in a brine of the Saginau valley, Dr. Chilton found 7·65 grms. of bromine; while at Tarentum, Pa., 6 grms. of bromine and 4 grms. of iodine were reported by M. Hieren. Bromine is, we learn further from this paper, manufactured in the United States in considerable quantity; that for the current year will amount to 125,000 lbs. Iodine is not at present manufactured in the States, the supply being obtained from Europe, where its manufacture is confined to Great Britain and France; the annual production of these countries amounts to 200,000 lbs. The average product of iodine is 10 lbs. to the ton of kelp; and, since it requires 20 tons of wet seaweed to produce 1 ton of kelp, this total represents 400,000 tons of seaweed. At the present price, the iodine produced is of more value than the alkaline salts. The chief consumption of bromine and iodine is for medicinal purposes, in the form of salts; a small proportion is consumed in photography. Bromine has been proposed as a discharge in calico-printing, and was, to a limited extent, used as a disinfectant during the late American war.

New Sulphur Deposit.—A. B. Taylor.—The deposit here alluded to is in the Island of Saba, a country of volcanic origin its highest point being about 2800 feet above sea level. In this island, a Netherlands' possession, sulphur was recently quite accidentally discovered by an enterprising New Yorker, who visited the island in search of health. With the aid of some of the natives, he succeeded in quarrying about two sloop-loads of the crude mineral, which, on being brought to New York, was found to yield, on average, rather over 60 per cent of sulphur, while the Sicily mineral only yields about 30 per cent. The deposit is, considering the small size of the island, very extensive, and is of great value for the manufacturing interests of the United States; and, since the island is distant only about 1500 miles from New

York, it need not be wondered at that leases have been secured of the best tracts of sulphur deposit there by American firms.

Roasting of Coffee.—W. Procter.—When a cold prepared extract of roasted coffee is distilled with lime or magnesia, an alkaline distillate is obtained, which, by evaporation, after the addition of hydrochloric acid, and extracting with alcohol, yields a pure chloride of methyl-ammonium. This product is formed by the decomposition of caffeine when combined with tannic acid, as is the case in all coffees; pure caffeine yielding different products of decomposition, among which is cyanogen. In roasting coffee, a portion of the caffeine is volatilised together with some methylamine, while the larger amount remains with the coffee itself; half of the caffeine of the coffee is decomposed in this way. One sample which, before roasting, was found to contain 1·45 per cent, yielded afterwards only 0·65 per cent. The temperature at which these changes are effected is, in the case of Porto Rico, or green coffee, 275°, and in that of Java, yellow coffee, 250° to 255°. Caffeine is soluble in bisulphide of carbon and benzol, and in the latter menstruum to such an extent, that it may be used with advantage to prepare the pure alkaloid from raw coffee.

Snake Poison and its Antidote.—S. B. Higgins.—To this paper, although not an original one, having been published in the *Chemist and Druggist* (London, June 15, 1870), we call the attention of those of our readers who happen to reside in countries where venomous snakes abound. The main gist of the contents of the memoir is, that the poisons of the poisonous snakes, and all animal poisons, have their specific antidote in the gall of the animal or reptile in which these poisons exist. The pure gall is mixed with very pure and very strong alcohol (95 per cent); 200 drops of that liquid, mixed with 20 drops of the gall, are thoroughly mixed; and of that mixture 5 drops are given at a time in half a tumblerful of water.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk (double number) May and June, 1870.

This number contains the following original papers and memoirs:—

Preparation and Constitution of Hyoscyamine in relation to the other Constituents of Semina Hyoscyami.—H. Hohn.—This lengthy monograph treats, in the first place, on the preparation of hyoscyamine from henbane seeds, carefully collected and fresh; secondly, the properties and composition of hyoscyamine are considered. The author found that hyoscyamine possesses, in a very high degree, the property of dilating the pupil of the eye; the alkaloid is precipitated by chloride of platinum only from concentrated solutions, and an excess of the platinum-salt re-dissolves the precipitate. The formula of the hyoscyamine is $C_{36}H_{23}N_2O_6+HO$; and the author states that this body may be viewed as atropine, 1 atom of H of which has been replaced by 1 atom of methyl-ammonium, C_2H_3,H_3N; and the formula of hyoscyamine may therefore be written—

$$C_{34}H_{22}(C_2H_3,H_2N)NO_6+HO.$$

The memoir further contains the following chapters:—Researches on a waxlike material obtained by the first purification of hyoscyamine in chloroform. The body herein alluded to has been called by the the author, hyoscerine, a body fusing at about 210°, devoid of taste and smell, not sublimable, insoluble in water, readily soluble in strong boiling alcohol, and best so in ether and chloroform; the formula of this substance is $C_{32}H_{30}O_6$. Hyoscyamus seeds, moreover, contain a peculiar glycoside. Hyoscypikrine, a peculiar volatile base, and a yellow-coloured nitrogen-containing resin; formula, $C_{112}H_{88}N_2O_{20}$.

Establishment and Capital required for the Manufacture of Artificial Mineral Waters, and on the Profits of that Trade.—Dr. E. Gressler.—This paper is a valuable contribution to our knowledge on this subject in a technical point of view; but, as regards the financial part of that business, it is only applicable to a portion of Germany.

Chemical Researches on the Fruit of the Laurel-Herb (*Daphne mezereum*), and more especially on a Fatty Oil contained therein.—Dr. A. Casselmann.—This monograph is divided into the following divisions:—Investigation of the fatty oil.—This is a so-called drying oil, present in the fruit of the above-named plant to a percentage varying from 24 to 31·3; sp. gr. of the oil at 15°, 0·8903; not solidified at −16°, and not altered by a temperature of 160°. When freshly pressed, this oil has a smell resembling that of cantharides; its taste is very acrid, but, by exposure to air for a few days, these characteristics are lost, owing to a change the oil undergoes by oxidation. The oil is readily soluble in ether, sulphide of carbon, and benzol, but very difficultly so in strong alcohol. This chapter treats, further, at great length, on the composition and constitution of this oil, the elementary constitution of which is expressed, in 100 parts, by—C, 76·69; H, 11·05; O, 12·26. The next division of this memoir treats on the investigation of the residue of the fruit after having been deprived of its fixed oil; and on the preparation of coccognine, a crystalline white-coloured body, readily soluble in alcohol, but not so in water; also soluble in ether. The composition of the fruit of the laurel-herb (a poisonous plant) is, in 100 parts—Ethereal, or essential oil, a trace; fixed drying oil, 31·0; resin and wax soluble in ether, 3·58; an acrid resin soluble in alcohol, 0·32; coccognine, 0·38; proteine compounds, 19·5; gum, mucilage, malic acid, bitter and colouring matters, and cellulose, 32·37; an organic matter (salts), 5·46; water, 7·39—total, 100·00.

Eau de Beauté de M. Bargasse.—Eau de beauté consists of—Bichloride of mercury, 80 centigrms.; camphor, 1 grm.; sulphate of zinc and solution of lead (*liquor plumbi acetici*), of each 4 grms.; rose-water, 250 grms.; and the yolk of one egg. This mixture is regularly in use (so the editor of this periodical states) by Creole ladies for beautifying their skin. A bottle containing this mixture in the above quantity is sold for about five shillings.

Polytechnisches Journal von Dingler, first number for June, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Description of an improved Pair of Compasses for Drawing Very Minute Circles.—M. Hellmann.—This description is accompanied by woodcuts.

Description of an Improved Zundnadelgeweter.—Dr. Dingler.

Analysis of Normal Fire-Clays adapted to the Manufacture of Various Objects.—Dr. C. Bischof.—This paper, which is, unfortunately too lengthy for any useful abstraction, contains, in the first place, a complete account of the methods of analysis of fire-clays, and the modes of testing these substances for their fire-resisting qualities. The author next details, at great length, a series of analyses of fire-clays, classified according to their value, beginning with a clay the resistance of which to fusion or softening is taken as =100, and ending with a clay which is only 10.

Glue which Stands Moisture without Softening.—Dr. Böttger.—Dissolve, in about 8 fluid ounces of strong methylated spirit, ½ an ounce of sandarac and mastic; next, add ½ an ounce of turpentine. This solution is then added to a hot, thick solution of glue to which isinglass has been added, and is next filtered, while hot, through cloth or a good sieve.

German Beer Bouquet.—Dr. Böttger.—This liquor consists of a solution of essential oil of lemons in light petroleum oil, and a coarse fusel oil containing spirit coloured by turmeric.

Second number for August, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Vertical Oil-Gas Retorts.—Dr. B. Hübner.—Illustrated with engravings.

Apparatus for Heating the Air of Hot-Blast Furnaces.—M. Whitwell.—Illustrated with a series of engravings.

On Cast-Iron, Wrought-Iron, and Steel, in reference to the Construction of Engines and Machinery.—Dr. Reiche.—This lengthy memoir treats on the physical, as well as chemical, properties of the materials alluded to, and on the defects they exhibit, due to the process of manufacture.

Behaviour of Sulphuret of Zinc while Exposed to Air.—A. Wagner.—The author records a series of experiments made with sulphuret of zinc, purposely prepared and left standing exposed to the air. The chief result of these experiments is, that sulphide of zinc hardly oxidises at all; and, for what little it does, it evolves sulphuretted hydrogen, and differs essentially from the sulphurets of iron and manganese, which become, under the same conditions, converted into oxides, sulphur being set free.

Preparation of Hydro-Fluosilicic Acid on the Small Scale.—F. Stolba.—The author describes, and illustrates with woodcuts, at great length and very minutely, the best method for the preparation of this reagent. The paper is too lengthy for useful abstraction.

Application of Rock-Salt to the Manufacture of Glass; and on the Direct Preparation of Soda Silicates from that Salt and Silicic Acid, both from Native and Artificial Silicates.—A. Ungerer.—Illustrated with a series of engravings.

Nitrogenous Substances Present in Beer: a Contribution to Brewing.—Dr. G. Feichtinger.—The author gives an exhaustive account of a series of experiments made with the view, not only to determine, quantitatively, the amount and nature of the nitrogenous matter present in beer, but also to show whence these nitrogenous compounds are derived, and the influence the various operations of the brewing process have upon the nature, as well as the quantity, of these substances. The chief result of these researches is that, a minimum excepted, the whole of the nitrogenous substances present in beer are derived from the albuminous matters present in the malt; and therefore the quantity of nitrogen found in the dry extract of beer may be calculated as albuminous matter.

Manufacture of Beer from Rice.—A. Belohnbeck.

Explanation of Steam-Boiler Explosions.—R. Wabner.—The author calls attention to the fact that hitherto no account has been taken of the possibility, which he proves to exist, that these explosions are occasioned sometimes by the formation of an explosive mixture of atmospheric air and the gases generated by the combustion of the fuel collected in the flues and tubes steam-boilers are provided with. The author gives instances of explosions which could be distinctly referred to this cause.

Preservation of Thallium.—Dr. Bœttger.—The author states that, after having tried several methods, he has found that this readily-oxidisable metal is best kept unaltered by being kept in pure distilled water which has been boiled for a long time, to expel air, and cooled in a closed flask. An ingot of thallium fused under a layer of cyanide of potassium, and immersed in the liquid just mentioned, has preserved its silvery metallic surface unaltered for three years.

Moniteur Scientifique, No. 330, September 15, 1870.

The only original papers in this number relate to *brevets d'invention*, among which we notice the following:—

Improvements in the Manufacture of Stearine (Stearic Acid).—MM. Weiss and Co.—The process relates to a method of cooling of the oleic acid, obtained by the pressure of the stearine cakes, to a temperature of −5°. The acid, which always contains a certain proportion of stearine in solution, becomes, thus, a semi-fluid mass, which is

immediately transferred to a centrifugal machine lined with flannel, and kept cold by artificial means. The drum of this machine, having been set in motion (making 1200 to 1300 revolutions a minute), the oleic acid is separated from the stearine, and the latter recovered.

Preservation of Grapes in the Fresh State.—J. B. F. Tremellat.—The bunches of grapes are cut so that a good portion of the stem remains attached, and that portion is introduced into suitably-constructed glass vessels, which, by means of tubes, inter-communicate with a reservoir always filled with water. The stems of the bunches of grapes placed in this apparatus are kept in a properly-constructed room, neither too hot nor too cold; and, in this manner, the evaporation of water is prevented and the fruit kept fresh.

Preparation of Organic Bases by Artificial Means, with the view to apply them to the Manufacture of Colouring Matters.—C. Bardy and L. Dusart.—The authors state that, when the compounds of the polybasic acids with phenols act upon certain alkaloids, the result is the formation of a new series of alkaloids, which contain the original alkaloid in combination with the radical of the phenol which has been employed. For instance, when a mineral or organic sulpho-phenate acts upon aniline, diphenylamine is obtained—

$$C_{12}H_5O.SO_2SO_2MO + C_{12}H_7N = C_{24}H_{11}N.SO_2.HO + SO_2.MO;$$

with a sulpho-phenate and naphthylamine, phenyl-naphthylamine is obtained; with sulpho-naphthalate and aniline, naphthylaniline. The authors give a lengthy description of the process they employ, which is chiefly confined to the operation of heating the various compounds under pressure at high temperatures.

Manufacture of an Extract of Madder suitable for Dyeing and Printing Purposes.—A. Rieu.—The author prefers to use, for his preparation, garancine, properly prepared and thoroughly stove-dried. This material is exhausted, in a properly-constructed apparatus, with boiling sulphide of carbon; the dry residue left after the evaporation of this liquid is treated with sulphide of carbon, in the cold, in order thereby to dissolve grease; after which, the colouring matter is left in the state of a semi-crystalline powder. This is converted into an aqueous paste, by being first dissolved in a very weak alkaline fluid, and precipitated by an acid from this solution, care being taken to avoid excess of acid. The flocculent precipitate thus obtained is washed by decantation, leaving an aqueous paste fit for direct use in the operations of dyeing and printing.

NOTES AND QUERIES.

Artificial Alizarine.—(Reply to R. G. Bennett.)—Your only plan is to find out whether the process has been proceeded with, which you may learn at the Great Seal Patent Office; or you might experiment according to the directions given in the specification you allude to.

Colouring Low-Priced Butters and Fats Yellow.—(Reply to "Young Chemist.")—We certainly cannot undertake to assist you in committing an adulteration, which, *de facto*, amounts to neither more nor less than fraud. If the substance you named and tried, and which, as you are aware, is generally applied, does not answer your purpose, there is no other colouring matter which can be used with safety.

Starch and Alcohol.—I wish to know the correct composition and atomic weight to take for starch. On consulting various authorities, they all differ; 81, 96, 153, 162, 180, 198, &c., are given, with, of course, a variable constitution. At the same time, I want to know the true *theoretical* quantity of alcohol obtainable from 100 parts of starch, and how arrived at.—SCIOLIST.

Extract of Indigo.—I shall be glad if you or any of your readers will kindly tell me what substances are used for weighting extract of indigo (acid and neutral), so that it keeps its transparency when viewed through glass; also the greatest amount that can be got from, say, 1 lb. of indigo, and the best way of getting rid of that greenish tinge which some extracts have. I have no work that gives any information upon this subject.—INDIGO.

Soap-Making.—(Reply to J. Y.)—One of the best books on the subject you refer to is "A General Treatise on the Manufacture of Soap," by Professor H. Dussauce (Philadelphia: H. C. Baird; and London: Trübner and Co., 1869). This work may be inspected at the Library of the Commissioners of Patents. As regards the experiments made by Mr. Clift, it does not appear that they were ever made public, but perhaps Dr. Crace Calvert could give more information on this subject.

A Good Suggestion.—This may be among the first notes that you receive written on the new post cards, and I have to suggest their utility for the purposes of your "Notes and Queries" column; their use would ensure brevity, and, also, the writing must be on one side only. There is little fear of any ordinary person profiting by their contents during the process of transmission, as the language of modern science is so beautifully simple that chemists themselves are often puzzled to comprehend it.—JOHN NEWLANDS.

TO CORRESPONDENTS.

T. A. White.—The method of using Woolfe's bottles is too well known to be described here.

J. R.—The latest German edition of "Fresenius" is referred to; the method of Lippert and Gintl is fully described in *Dingler's Polytechnisches Journal*, vol. cxc., p. 113, 1868, but there is not, as far as we are aware, an English translation of this paper.

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ON THE ELECTRO-DEPOSITION OF COPPER AND BRASS.*

By W. H. WALENN, F.C.S.

THE present condition of the electro-deposition of copper and brass is put forward, in this paper, with sufficient reference to the history of the subject to enable comparatively recent improvements to be well understood, but treating the process in a practical manner and with reference to some improvements and manipulations that are adopted by the author.

The history of electro-metallurgy, as set forth by Smee, in 1851, comprises only that part of the subject which relates to the electro-deposition of metals from their neutral or acid solutions. With some isolated exceptions, no alkaline solution is there treated of. He therefore arrives at the conclusions—(1) That if hydrogen gas is evolved from the cathode during deposition, non-reguline metal is deposited; (2) that up to 1851, alloys were not able to be deposited by means of electricity, but that possibly they might be deposited without the evolution of hydrogen gas, by employing an "intense voltaic current."

To contrast with these views, it appears that, in 1851, there were from three to five practical methods of electro-depositing brass; and the present state of electro-deposition (independent of the improvements worked out by the author) shows that hydrogen gas is usually evolved from the cathode in copious bubbles during the deposition of reguline, but somewhat porous alloy from cyanide solutions, an intense voltaic arrangement being employed, in some respect to compensate for the waste of power induced by the evolved gas. The electrolysis of the solution of cyanide of copper in potassic cyanide also forms an exception to Smee's law for obtaining reguline metal, for during successful reguline deposition, hydrogen gas is evolved freely from this solution.

In alkaline solutions, the proneness to evolve hydrogen during deposition arises from the comparatively small quantity of metal in solution, and from the disposition of the metal of the alkali to go to the negative pole. The first cause can be removed by using a solution containing a greater percentage of metal than that usually employed; the second cause can be eradicated by providing, in excess, a decomposable compound radical that will take a certain amount of combined oxygen with it to the cathode.

Ordinarily, a solution containing the cyanides of copper and zinc, respectively, dissolved in a "solvent solution" consisting of a mixture of potassic cyanide with a salt of ammonium, is employed to deposit brass. This solution, however, evolves hydrogen copiously, and is only workable by means of two Grove's cells. The author finds that the evolution of gas may be either totally stopped, or much lessened, by dissolving as much of the metallic cyanides as the solution will take up, and then further charging the solution with the copper and zinc oxides. The evolution of gas may be totally stopped by the further addition of cupric ammonide, which may possibly carry the combined oxygen to the cathode according to the following equation:—

At the cathode before chemical reaction.

$$\underbrace{\{Cu_2O,4NH_3+4H_2O\}}_{\text{Cupric ammonide.}} + \underbrace{H_2}_{\text{Hydrogen.}}$$

At the cathode after chemical reaction.

$$= \underbrace{Cu_2}_{\text{Copper.}} + \underbrace{4NH_3}_{\text{Ammonia.}} + \underbrace{5H_2O}_{\text{Water.}}.$$

Malaguti and Sarzeau's formula for cupric ammonide being used. That is to say, before decomposition or chemical reaction takes place, the whole of the cupric ammonide, together with the eliminated hydrogen, goes to the cathode; after the decomposition or chemical reaction has taken place, metallic copper is deposited, ammonia is in solution, and water is formed.

In treating the ordinary cyanide copper solution for the prevention of the evolution of hydrogen, the zinc cyanides or oxides, mentioned in the instance of the brass solution, are left out.

When the evolution of hydrogen has been stopped, a single Smee's cell is sufficient to deposit the alloy; but, in practice, a single Grove's cell, or equivalent magneto-electric power, is employed, in order to shorten the time of immersion in the electro-coating bath.

The author prefers to use potassic cyanide and neutral ammonium tartrate, when mixed with water, to form the solvent solution for either brass or copper. The quality of brass (yellow or red) depends upon the heat of the solution.

Acid solutions, in general, give a spreading, or matted deposit; alkaline solutions, a bristling one. The contact of the coating is promoted by working the solution hot. The article should be pickled, scrubbed with sand, washed, scrubbed with a portion of the depositing solution, and then placed in the depositing trough; after deposition, the article is washed, and dried in hot mahogany sawdust. Complete protection from rust, and a satisfactory coating for any purpose, is given by the use of the acid-depositing bath subsequent to that of the alkaline bath.

The subject-matter of this paper is illustrated by a calico-printing roll, weighing 125 lbs., with 29 lbs. of deposit upon it; and by twenty other results of the inventor's improvements.

The coating by means of the author's method of working is superior to that of any other known process. The invention is set forth, in detail, in Specifications Nos. 1540 (A.D. 1857) and 3930 (A.D. 1868); and it is applicable to the prevention of rust, the coating of plungers and other portions of machinery, and the lining of cylinders, &c. It is also applicable to architectural and other castings, and to many purposes which require the strength of iron and the beauty of brass.

* Abstract of a paper read before the British Association, Liverpool Meeting, Section B.

ON THE PHENOMENA OF THE CRYSTALLISATION OF A DOUBLE SALT.*

By J. BERGER SPENCE, F.C.S.

As an illustration of a double salt, we cannot have a more forcible example than the tribe of alums.

As a rule, it is generally supposed, with one exception, they are easily made and crystallised.

Seeing the supposed difficulty which seems to surround this one exception, I was led to make many experiments to ascertain where the real difficulty lay, and in the following pages are a few of the records of my experiments.

In the manufacture of alum it would be a great desideratum if the manufacturer could dispense with the expensive items of ammonia and potash, and substitute soda in the production of this double salt, because the ammonia and potash are of no value to the paper-maker or the dyer. If these constituents could be given to the agriculturists it would be a benefit to both parties.

My attention has for some time been directed to this question, and I have made a considerable number of experiments to ascertain whether soda-alum could be produced as easily and as economically as its sister salts. I believe little or nothing was known of this compound before the beginning of this century. The first mention I have seen of it is in Ure's "Dictionary," where it says, "Mr. Winter first mentioned that another variety of alum

* Read before the British Association, Liverpool Meeting, Section B

can be made with soda instead of potash, and that it is very difficult to crystallise." In Knapp's "Technology," the analysis of a natural soda-alum from South America is given. Watts's "Dictionary" says that it is found native in the island of Milo, in the Grecian Archipelago. Very few chemical works mention it fully, and most of the writers seem impressed with the idea that it is very difficult to crystallise. On this subject I have been experimenting for some months, and I find that the crystals can easily be produced if boiled down to the proper strength. The following are a few of my experiments:—

I prepared solutions of sulphate of alumina and sulphate of soda in their combining proportions to form alum. I boiled these solutions to 18°, 28°, 39°, and 47°, by Twaddle's hydrometer, and allowed them to stand for twenty-four hours; at the end of that time no crystals had made their appearance. In the case of ammonia-alum, a plentiful crop would have been obtained at 39° and 47°. It was not my object to make soda-alum from its equivalent salts, as that would be rather an unprofitable undertaking. These experiments were simply performed to find out the degree of crystallisation.

7000 grains of sulphate of alumina and 3360 sulphate of soda were dissolved and mixed; the solution was boiled down to 50°. It was standing for two days, and the yield of crystals was 150 grains. The cold solution was 65°; the mother-liquor was boiled to 67°. On cooling the solution, a white amorphous mass was formed (of this white mass I shall have to speak further on), which was re-dissolved and boiled down to 60°, and the yield of crystals was 4400 grains. The mother-liquor from the second crop was again boiled down to 60°, and the yield of crystals was 2390 grains. The total amount from the three crystallisations was 6940 grains.

The same quantities of salt were taken and boiled to 45°; 500 grains of strong sulphuric acid were added, which raised the strength to 52°; it stood for two days, and the yield of crystals was 260 grains. The mother-liquor was boiled down to 58°; the yield of crystals was 3700 grains, but these crystals did not look like pure alum, as they were more like sulphate of soda with crystals of alum interspersed. The solution was again boiled down to 60°; the crystals weighed 2200 grains. The total yield was 6160 grains.

A third experiment was made with the same quantity of salts, and the strength boiling was 55°. The yield was 2420 grains. The mother-liquor was boiled to 62°; the crystals weighed 3200 grains. The third crystallisation gave 1800 grains. The yield from the three was 7420.

Having now determined the crystallising-point, I proceeded to act upon shale which contained about 26 per cent of alumina. 1000 grains of calcined shale was treated with 400 grains of strong sulphuric acid boiled with water. 1000 grains of sulphate of soda was added, and the solution boiled down to 60°. The yield of crystals was 600 grains.

A second lot of shale, with three crystallisations, 1670.

The same quantity of shale, with sulphate of ammonia and one crystallisation, 3090 grains.

2000 grains of shale, and the equivalent quantity of acid and soda, were added; the solutions boiled to 74°. No crystals were formed, but instead, an amorphous mass. This was re-dissolved, and the strength was 71°; still this amorphous mass was formed. After three days, this magma was gradually transformed into crystals, and the yield was 1680 grains. The mother-liquor was boiled to 62°, stood for two days, and the crystals weighed 1210 grains. The mother-liquor in the third crystallisation yielded 450 grains. The total amount of crystals was 3340 grains.

The same experiment with shale and sulphate of ammonia and one crystallisation, 6180 grains.

My last and conclusive experiments were made upon soda and ammonia-alums, so that, by comparison, I should be enabled to judge whether sulphate of soda or sulphate of ammonia would be the most economical for forming alum. The atomic weight of the two salts was taken, and boiled to different degrees of specific gravity. Twaddle's hydrometer was used, and the solutions were all allowed about the same time for crystallisation.

100 parts of a mixture of sulphate of alumina and sulphate of soda, in their atomic proportions, will form 113·3 parts of soda-alum—

$$[Al_2O_3]3SO_3 + 18HO. \quad NaOSO_3.$$

100 parts of the mixed salts were boiled down to 30° to see how much alum would be formed, likewise to 40°, 50°, and so on.

Soda-Alum, $Al_2O_33SO_3 + NaOSO_3 + 24HO$.

	Deg.		Percentage of alum.
100 parts boiled to	30	gave	*nil*
,, ,,	40	,,	*nil*
,, ,,	50	,,	14·0
,, ,,	60	,,	33 6
,, ,,	62	,,	39·1
,, ,,	64	,,	47·6
,, ,,	68	,,	54·3
,, ,,	72	,,	61·8
,, ,,	76	,,	67·3
,, ,,	80	,,	68·3

Ammonia-Alum, $Al_2O_33SO_3 + NH_4OSO_3 + 24HO$.

100 parts of a mixture of sulphate of alumina and sulphate of ammonia, in their equivalent proportions, will form 113·5 of ammonia-alum.

	Deg.		Percentage of alum.
100 parts boiled to	30	gave	89·10
,, ,,	40	,,	91·50
,, ,,	50	,,	97·50
,, ,,	60	,,	101·26
,, ,,	62	,,	102·10
,, ,,	64	,,	103·00
,, ,,	68	,,	104·90
,, ,,	72	,,	106·10
,, ,,	76	,,	108·00
,, ,,	80	,,	111·80

When the alums are formed and are re-dissolved and re-crystallised the loss is very considerable in the case of soda-alum, as the following table will show.

A definite quantity of alum was dissolved in water, and boiled down as before to various specific gravities.

When soda-alum was boiled to 20° no crystals were formed, but in the case of ammonia-alum 80·15 per cent crystallised out.

Percentage of Alum which Crystallised Out at Varying Specific Gravities.—In most cases 4000 grains of the salts were taken: the solutions stood about twenty hours, but in the case of the soda-alums the solution stood a much longer time, as at 40°, 50°, and 60° not a crystal was formed at the end of twelve hours; the solutions were well stirred and then set aside for twenty-four hours.

Soda-Alum.

	Deg.		Percentage alum.
100 parts of crystals boiled to	20	.. ..	*nil*
,, ,, ,,	30	.. ..	*nil*
,, ,, ,,	40	.. ..	*nil*
,, ,, ,,	50	.. ..	29·70
,, ,, ,,	60	.. ..	34·92
,, ,, ,,	63	.. ..	59·57
,, ,, ,,	68	.. ..	72·72

Ammonia-Alum.

	Deg.		Percentage alum.
100 parts of crystals boiled to	20	.. ..	80·15
,, ,, ,,	30	.. ..	88·75
,, ,, ,,	40	.. ..	98 00
,, ,, ,,	50	.. ..	99·00
,, ,, ,,	60	.. ..	09·40
,, ,, ,,	63	.. ..	99·50
,, ,, ,,	68	.. ..	99·70

By these tables we see the very great disparity which exists, as regards the solubility of the two salts. At 68° soda-alum is more than 25 per cent behind ammonia-alum

at the same strength, and again it requires from three to four days for the crystals of soda-alum to form, whereas a few hours was sufficient for the ammonia salt.

In the first portion of this paper I have mentioned several times about a white amorphous mass which I always found on boiling the solutions of soda-alum to a high specific gravity. In my first experiments this annoyed me considerably, as I saw no way of overcoming the difficulty. Once when I boiled a solution of soda-alum to 68°, the customary white mass appeared on cooling. I put it on one side for a day or so, and on again examining it, I saw the surface was crystalline. I allowed it to stand for a few days longer, and day by day I watched it. The solution was put aside in a beaker so that I was enabled to watch the growth of the crystals. I was surprised to find at the end of the week that the whole of the white mass had disappeared, and in its place were large crystals of alum. It was most interesting to study the growth of the crystals as they grew from the top downwards, and according to the quantity of the amorphous mass so is the time for the crystals to form. I have examined this mass under the microscope with a quarter inch glass to see if I could detect any form; there was not the slightest crystalline appearance. The only explanation of this singular phenomenon which I can give is, that the alum is not really formed until the crystals appear, and time is requisite for them to unite and form the double salt; or again, may it not be that the high temperature to which the alum is exposed at the high specific gravity drives off the water of crystallisation, or some of it, thus giving an alum with minus its equivalent of water.

The important point was then to see the exact degree where the crystals merged into the amorphous condition and *vice versâ*. For that experiment I used the mother liquors from the various crops of crystals.

The first portion was boiled to 64°: after twelve hours there was a crop of good crystals with a little of the amorphous mass mixed with the crystals.

At 65° a white mass with a honeycombed structure with crystals in the small holes.

At 66°, after twelve hours, half was a white mass, and the other half was crystals.

At 67°, after twelve hours, a white mass with very little signs of crystallisation about it.

At 63° the same as 67°.

The next point to determine was to ascertain how long it was before the white mass became converted into crystals. Here I found a variation extending from days to weeks, according to the strength of the solutions. The solution, which was boiled down to 63°, required three days for the crystals to form. One at 68°, a week. At 74° and 76° required three weeks, and another at 84° did not show any sign of crystallisation even at the end of three weeks, but was a white cake without mother liquor. On breaking the cake up, here and there crystals of alum were to be seen, bearing a faint resemblance to Fontainebleau sandstone.

From these experiments to obtain crystals we learn that the solutions should be at 60° at the boiling temperature, but they must not exceed 62°. Where time is of not much object the solutions may be boiled down to 68°. or even 70°.

On dissolving the crystals of soda-alum in water which is moderately hot, the white powder makes its appearance, and disappears in boiling. In this case, may it not be the sulphate of soda is dissolved first, leaving the sulphate of alumina to be dissolved afterwards. It will be seen that it is almost impracticable to make soda-alum on the large scale in competition with its sister compounds, when, in the first place, it is found that the solutions vary considerably in their crystallising power, for I have found sometimes that I could procure the crystals in two days, when at other times they have taken a week to form. Yet if the boiling solution is kept at 62°, a good crop may be reaped, though it would be much smaller than ammonia-alum under the same circumstances. In the second place, the white amorphous mass which is formed in strong solutions would present considerable difficulties on the large scale, though, if time be given, ultimately the whole mass will be converted into crystals. Here, again, the time varies in the transformation of the amorphous to the crystalline condition. From the four experiments which I made on the mother liquors, boiling them to various specific gravities, the amorphous masses were several days in the transition state. In the case of another solution boiled to 68° it required six days for their complete conversion, and the higher the degree the longer is the time required for the change. I found if the masses were allowed to remain undisturbed the change was quicker than when they were disturbed with a rod.

In the third place, the excessive solubility of the salt is, I think, an insuperable difficulty; for if we turn back to the table of comparison, we find that when the soda-alum is re-crystallised and boiled down to 63° it takes three days for the crystals to form, and the percentage obtained is only 59·57, whereas, in the case of ammonia-alum, twenty-four hours are all that is required, and the percentage is 99·5.

The crystals of soda-alum differ a little in their form from the ordinary alums. The finest crystals are obtained from the amorphous mass, and these are octahedrons covered with minute triangles, as if the crystals were built up from the sides of pyramids.

There is certainly one advantage which the soda-alum possesses; that is, the cost of the sulphate of soda is trifling compared with sulphate of ammonia; and as the consumption of this latter material is gradually increasing, owing to its high value as a fertiliser, and as the agriculturist is now beginning to see the great value of these nitrogenous products, and as their value is lost in alum, it may ultimately, now that the practicability of producing soda-alum on the commercial scale has been demonstrated, even with all the difficulty of crystallisation, be a more economical way of producing this double salt.

ON THE RETENTION OF ORGANIC NITROGEN BY CHARCOAL.*

By EDWARD C. C. STANFORD, F.C.S.

TWELVE months' additional experience of the method of removing house excreta, which I introduced in a paper read before this Section last year, has fully confirmed all the advantages I then claimed for it. The use of X charcoal—that is, charcoal derived from the excreta itself—fully meets the only difficulties urged against the use of a dry system in large towns. The great power of the deodoriser employed reduces to a minimum the quantity required; and the source of supply is constant. Practically, once a year is quite often enough to empty the vault of an ordinary house; the amount to be removed is less than the house ashes, and the removal is even less offensive.

It has been applied to a large work and a number of private houses, and all who have inspected these acknowledge the arrangements to be a perfect solution of the difficulty. The process secures the whole value of the excreta, either to apply direct to the land, or in the form of sulphate of ammonia, and an animal charcoal second in value only to that derived from bones.

The only serious chemical objection that has been raised against the use of charcoal is, that its action upon organic nitrogenous matter is generally assumed to be that of a powerful oxidiser. Its powerful action on the carcase of an animal buried in it has led to the conclusion that the nitrogenous matter is oxidised into nitrates. It is, at any rate, a common opinion amongst chemists that charcoal

* Read before the British Association, Liverpool Meeting, Section B

cannot be economically used in fish or flesh manures, because, in some way or other, the manure loses a good deal of its nitrogen. This opinion rests on insufficient evidence. The action of charcoal on organic nitrogenous matter has never, as far as I know, been the subject of definite investigation. Is there a loss of nitrogen, and if there is, what becomes of it? These are questions which at present cannot be decidedly answered.

Dr. Stenhouse, in a lecture delivered at the Royal Institution, in 1855, first brought the subject forward; he found appreciable quantities of nitric acid in wood charcoal which had covered the body of a dog for six months. But the actual results of mixing nitrogenous animal matters with different kinds of charcoal have never been thoroughly investigated. The subject is important; and I am induced to submit some incomplete researches, as a first instalment of what promises to be a wide field of inquiry. Its bearing on the profitable use of charcoal as a means of securing the whole value of town excreta is obvious. Any serious loss of nitrogen would invalidate the process.

I showed, last year, that, with either fluid or solid excreta, there was no loss, as far as my experiments had extended. I pointed out, also, that I expected no loss from oxidation, as both must already be regarded as oxidised compounds. My experiments since extend over a long period, and I have included meat as one of the nitrogenous matters used; in all, however, I find no loss of nitrogen, no oxidation. and no formation of nitrates. Three mixtures were made on March 1st, and left in loosely-covered dishes in the laboratory—

No. 1 consisted of ½ lb. of meat cut in fine pieces, and ½ lb. of seaweed charcoal from tangle.

No. 2.—10 lbs. of urine, and 1 lb. of seaweed charcoal, evaporated down to about 2 lbs.

No. 3.—2 lbs. of the ordinary produce of the dry closet used with charcoal, which contains about equal parts of mixed excreta and X charcoal.

The mixtures were not weighed again till May 7th, and then were weighed and tested monthly for nitrogen till September 7th. The following table shows the weights, in ounces, and percentage analyses:—

	Meat.		Urine.		Excreta.	
	Weight.	Nitrogen.	Weight.	Nitrogen.	Weight.	Nitrogen.
	ozs.	per cent.	ozs.	per cent.	ozs.	per cent
May 7th ..	9·50	2·36	23·00	5·75	14·00	1·08
June 7th ..	9·25	2·14	22·75	5·52	13·75	1·06
July 7th ..	9·00	2·19	22·50	5·50	13·50	1·06
August 7th ..	8·75	2·22	22·25	5·62	13·25	1·10
September 7th	8·50	2·14	22·00	5·50	13·00	1·10

There was no loss of weight after May 7th, the differences in the table being the amounts taken for analysis. The nitrogen was estimated by combustion with soda-lime and precipitation with platinum; except in the case of the urine, where the proportion was large enough to estimate the ammonia by test-acid. Large samples were taken to ensure uniformity. The mixtures were all difficult to sample; and when this is considered, the variations in the analyses are within the limits of error. They conclusively show that for six months there was no loss of nitrogen; no trace of nitrates could be detected. I regret that I have no data between the time of mixing and May 7th, but I fully expected to see the nitrogen in the meat experiment gradually diminish, so as to compare it with the other two experiments, where I expected the nitrogen to remain constant. I have others in progress which will supply this omission. The nitrogens are, however, pretty near the theoretical quantities. At any rate, the experiments show that mixtures of various nitrogenous matter of animal origin remained mixed with seaweed charcoal and X charcoal in a perfect state of deodorisation, and freely exposed to the air without the formation of nitrates or loss of nitrogen; and this is all I wish to prove for the present. I hope, in a subsequent paper, to show also the effect of wood and bone charcoal on meat, both dry and moistened with water, which will probably materially effect the result.

I choose these charcoals as the representatives of the opposite ends of the charcoal series—the former being nearly pure carbon, and the latter containing but little carbon comparatively. Seaweed charcoal and X charcoal have a composition about intermediate; as both, however, contain a good deal of carbonate of calcium, I would expect them to pre-dispose to the formation of nitrates.

Charcoal is the best medium for converting fish and flesh offal of all kinds into inoffensive manure, if the nitrogen can be retained; I expect to show that the fear of its loss is, to a great extent, unfounded.

NOTE ON CLAUDET'S PROCESS FOR THE EXTRACTION OF SILVER.*

By J. ARTHUR PHILLIPS.

It is well known to the chemical trade that a remarkable increase in the price of brimstone took place in the year 1838, when the King of Naples granted a monopoly of Sicilian sulphur to Messrs. Taix and Co., of Marseilles, and that the immediate result was the employment of iron pyrites, as a source of sulphur, in the manufacture of sulphuric acid.

The consumption of this mineral rapidly increased from that date, and for many years the supply was principally derived from the mines of Cornwall, and from those of Wicklow, in Ireland.

About the year 1853, pyrites, containing a small percentage of copper, began to be imported from Spain and Portugal, and considerable quantities of ordinary pyrites are now also derived from Norway.

The increased importance of this branch of industry will, however, be appreciated when it is stated that the annual consumption, in the United Kingdom, of pyrites for the manufacture of sulphuric acid is now about 350,000 tons, of which at least 250,000 tons contain a sufficient amount of copper to render its treatment for that metal commercially advantageous.

The principal mines from which the chemical trade is supplied with cupreous pyrites are those of Mr. James Mason, at San Domingos, in Portugal, and those of the Tharsis Sulphur and Copper Company, in Spain.

The ores from these localities do not differ very materially from each other, and the following analysis, of a specimen from Mr. Mason's mines, may be taken as representing an average sample:—

Analysis of Mason's Pyrites.

Sulphur	48·90
Arsenic	0·47
Iron	43·55
Copper	3·10
Zinc	0·35
Lead	0·93
Lime	0·20
Insoluble rock	0·73
Moisture	0·70
Oxygen and loss	1·07
	100·00†

In the manufacture of sulphuric acid this pyrites is burnt in kilns supplied with a limited amount of air, the products of combustion being from thence conducted into

* Read before the British Association, Liverpool Meeting, Section B

† In addition to the above, this pyrites yields traces of thallium, cobalt, nickel, manganese, silver, and gold, and occasionally bismuth and antimony. See Mr. Claudet's analysis, *Journal of Chemical Society*, May, 1868.

leaden chambers, as in the case of vitriol manufactured from ordinary brimstone.

The resulting residue, or "burnt ore," was formerly to a large extent smelted for copper, and from the great amounts of oxide of iron present, acted as a valuable flux for the more siliceous ores of that metal.

Burnt ore resulting from the treatment of pyrites from the San Domingos Mines may be taken as having the following percentage composition:—

Analysis of Burnt Ore from the San Domingos Mines.

Sulphur	3·66
Arsenic	0·25
Iron	58·25 = 83·00 Fe_2O_3
Copper	4·14
Zinc	0·37
Cobalt	traces
Lead	1·24
Lime	0·25
Insoluble matter	1·06
Moisture	3·85
Oxygen and loss	26·93
	100·00

Silver 18 dwt. per ton.

Soluble in water = sulphate of copper 4·12 per cent = = 1·65 Cu.

For several years past a large proportion of the burnt ore produced in the various chemical works of the country has been worked by what is known as "the wet process of extraction." The principal advantage of this method of treatment arises from the circumstance that the resulting "purple ore" or "blue billy" is a saleable product, and is largely employed, both in the blast-furnace and for "fettling" puddling furnaces.

By the process of liquid extraction at present usually employed, the burnt ore is first finely ground and sifted, and subsequently roasted with common salt until, by the oxidation of the metallic sulphides present, a portion of alkaline salt is converted into sulphate of soda, whilst the copper is, on the contrary, transformed into a soluble chloride.

The copper salt is subsequently removed by repeated washings, and the copper precipitated by iron in the metallic state, whilst the residual purple ore remains in the washing-vats.

It has been long known to those engaged in this business that the copper precipitate produced not only contains a notable quantity of silver but also distinct traces of gold. No attempt, however, to separate the precious metals, and to turn them to profitable account, had been made up to the commencement of the present year, when Mr. F. Claudet patented a process for the separation of silver from ordinary copper liquors by the addition of a soluble iodide.

The amount of silver present in burnt ore seldom exceeds 18 dwts. per ton; but as the whole of this is never obtained in solution, it follows that, dealing with such minute quantities, in order to obtain satisfactory commercial results, the process employed should be both cheap and expeditious.

The vats, in which the burnt ore which has been roasted with salt are lixiviated, generally receive some eight or nine successive washings, with either water or with water acidulated by hydrochloric acid, and of these the first three only contain a sufficient amount of silver to be worth working.

For the purpose of removing the soluble salts from the ground and washed ore, hot water is employed, and as a large proportion of the chloride of sodium used remains undecomposed, it acts as a solvent for the chloride of silver produced during the process of furnacing.

The analysis of the first washings from a copper tank gave the following results:—

Analysis of Strong Liquors. Contents per gallon of 70,000 grains. Sp. gr. by hydrometer 1·240.

	grs.
Sulphate of soda	10,092
Chloride of sodium	4,474
Chlorine (combined with metals)	4,630
Copper	3,700*
Zinc	480
Lead	40
Iron	32
Calcium	52
Silver	3·06

As, Sb, Bi, &c., not estimated.

Total Chlorine .. .. 7,347 = 12,106 NaCl.
,, Sulphuric acid .. 5,686 = 2,274 sulphur.

Proportion of copper to silver contained—

Copper	10,000
Silver	8·2

The respective amounts of copper, chlorine, sulphur, and silver contained per gallon in nine successive washings of one tank of ore are given in the following Table:—

Copper Liquors from nine washings of one Tank of Ore.

No. of washings.	Sp. gr.	No. of grains per gallon of 70,000 grains.			
		Copper.	Chlorine.	Sulphur.	Silver.
1st	1·285	5,230	10,798	1,324	4·06
2nd	1·250	4,600	9,079	1,455	3·25
3rd	1·175	1,935	3,215	1,881	1·05
4th	1·080	646	717	1,255	0·19
5th	1·095	666	643	1,436	0·12
6th	1·070	692	544	1,588	0·06
7th	1·060	342	217	938	0·03
8th	1·030	200	—	434	0·06
9th	1·020	117	—	294	0·04

Washings 1 and 2 contain 82·50 per cent of total silver.
,, 1, 2, and 3 contain 94·30 ,, ,, ,,

The several operations for the extraction of silver are conducted in the following manner; and as the first three washings contain nearly 95 per cent of the total amount of that metal dissolved, these alone are treated.

These liquors are first run into suitable wooden cisterns, each of a capacity of about 2700 gallons, where they are allowed to settle. The yield of silver per gallon is now ascertained by taking a measured quantity, to which are added hydrochloric acid, iodide of potassium, and a solution of acetate of lead. The precipitate thus obtained is thrown upon a filter, and, after being dried, is fused with a flux, consisting of a mixture of carbonate of soda, borax, and lampblack. The resulting argentiferous lead is passed to the cupel, and, from the weight of the button of silver obtained, the amount of that metal in a gallon of the liquor is estimated.

The liquor from the settling-vat is now allowed to flow into another of slightly larger capacity, whilst, at the same time, the exact amount of a soluble iodide, necessary to precipitate the silver present, is run into it from a graduated tank, together with a quantity of water equal to about one-tenth the volume of the copper liquor. During the filling of the second tank its contents are constantly stirred, and, when filled, a little lime-water is added, and it is allowed to settle during forty-eight hours.

The supernatant liquors are, after being assayed, run off, and the tank again filled, when the precipitate collected at the bottom is, about once a fortnight, washed into a vessel prepared for its reception.

This precipitate is chiefly composed of sulphate of lead, iodide of silver, and salts of copper, from which the latter are readily removed by washing with water acidulated by hydrochloric acid. Thus freed from salts of copper, the precipitate is decomposed by metallic zinc, which reduces the iodide of silver completely, and, to a certain extent,

* 405 grs. of this copper exist in the state of subchloride.

also the sulphate of lead. The result of this decomposition is—

1st. Iodide of zinc, which, after being standardised, is employed in subsequent operations to precipitate further quantities of silver.

2nd. A precipitate rich in silver, and also containing a valuable amount of gold.

The more important constituents contained in a sample of this substance were estimated with the following results:—

Moisture 25 per cent. Rough Analysis of Dried Sample.

		oz.	dwt.	gr.	
Silver	4·455 per cent =	1455	6	0	per ton.
Gold	0·0595 =	19	8	12	,,
Zinc	15·440				
Lead	56·400				
Copper	0·600				
Lime	1·100				
Iron	0·700				
Sulphuric acid	6·680				
Insoluble ..	7·600				

The results of nearly six months' experience of this process at the Widnes Metal Works show that ½ ounce of silver and 1½ grain of gold may be extracted from each ton of ore worked at a total cost, including labour, loss of iodide, &c., of 8d. per ton, or 1s. 4d. per oz. of silver produced. If from this amount be deducted 6d., the value of the 3 grs. of gold contained in each ounce of silver, the cost of production, per oz. of silver, will be reduced to 10d., and the expense of working a ton of ore to 5d. This leaves a profit of about 2s. on each ton of ore worked.

The value of the precious metals extracted from each ton of ore treated is certainly not large, as the amount originally contained is very small. With richer ores, however, more satisfactory results would be obtained; but when it is stated that some of the copper extraction works operate on 30,000 tons of ore annually, it becomes evident that a profit of 2s. per ton is a most important consideration in a business in which vigorous competition has rendered the exercise of the strictest care and economy absolutely necessary.

ON THE ESTIMATION OF MANGANESE IN SPIEGELEISEN.

By J. SPEAR PARKER.

When making determinations of manganese in spiegeleisens, I have frequently been struck by the fact that, when the solution is coloured blue by the presence of copper, that colouration invariably disappears after precipitation of the manganese as hydrated dioxide.

The method of analysis used is as follows:—The finely-divided spiegeleisen, after solution in hydrochloric acid, is peroxidised with potassium chlorate; the excess of chlorine boiled off, the solution diluted, brought to boiling, neutralised with ammonia, and the iron precipitated by addition of a boiling solution of ammonium acetate (feebly acid). After boiling for an hour, the precipitate is allowed to subside, then filtered and washed with boiling water. The residue is dissolved in hydrochloric acid, and the precipitation repeated. The two filtrates are concentrated to a small bulk by evaporation. When copper is present in appreciable amount, this solution has a distinct blue tint. If necessary, the solution is again filtered, carefully washed, the filtrate heated, slight excess of ammonia added, and bromine till the manganese is completely precipitated. After standing for twelve or eighteen hours, the precipitate is filtered; the filtrate is always colourless. The burning of the filter-paper, too, would generally communicate to the flame the peculiar green colour which is characteristic of compounds of copper.

A spiegeleisen usually contains 0·2 or 0·3 per cent of copper—sometimes 0·5, or even more; therefore the precipitation of the copper with the manganese would seriously impair the accuracy of the determination.

To place the matter beyond a doubt, the following experiments were tried:—The ignited proto-sesquioxide of manganese, obtained from 20 grains of a spiegeleisen containing copper, was dissolved in hydrochloric acid; the solution, which was of a bright green colour, was diluted and transferred to a weighed platinum crucible. A piece of pure zinc was added, and the crucible was almost immediately covered with a copper-red deposit. After complete precipitation of the copper, and solution of the zinc, the liquid was decanted, and the crucible washed several times with boiling water (allowing the particles to subside, and then decanting); finally, dried in the water-bath. The copper thus obtained weighed 0·07 gr.

A solution of manganous sulphate was then prepared, and two equal quantities measured by a pipette. The one after heating with ammonium acetate was precipitated by bromine; to the other, about a grain of crystallised cupric sulphate was added, and precipitation effected as before.

The proto-sesquioxide obtained from the first weighed 1·582 grs.; from the second, 1·823. The copper estimated in this gave 0·188 gr., equivalent to 0·235 gr. of cupric oxide. Subtracting this from the total weight of the second precipitate, leaves 1·588 grs.

By direct determination, manganese = 1·144 grs.

Precipitated with copper, which was subsequently determined and calculated to exist as CuO, manganese = 1·140 grs.

To ascertain how much copper it was possible to precipitate with the manganese, a solution containing cupric and manganous sulphates, in equal amount, was precipitated with bromine (keeping the solution as nearly as possible neutral).

The precipitate is of a lighter brown when containing copper than the pure hydrated dioxide. On igniting, it first changed to a fine black colour; after strong and protracted ignition, to brown black. After weighing, the copper was determined as before—

Mn_3O_4(+CuO) = 2·98 grs.
Copper = 0·70 ,,

This is equivalent to 0·88 gr. of CuO; subtracting from the first amount, leaves 2·10 grs. of Mn_3O_4, which contains 1·51 grs. of metallic manganese. There is, therefore, nearly 1 equivalent of copper to 2 of manganese. The copper can be extracted from the moist precipitate by boiling with strong solution of ammonia, or by digestion with cold dilute sulphuric acid (in the latter case, a small portion of manganese also is dissolved). It is probably present as a manganite of copper, corresponding to Mr. Weldon's acid manganite of calcium. This compound seems to be somewhat unstable; for if, during precipitation, the solution be allowed to become more strongly acid, or if, on the other hand, excess of ammonia be maintained throughout, the proportion of copper is considerably diminished, especially in the latter case.

Two methods may be used to remedy this error: either to separate the copper previous to the precipitation of the manganese; or to determine the amount of copper in the ignited oxide, and then subtract an equivalent amount of cupric oxide from the total weight of the precipitate.

In using the first method, 20 grains of the finely-divided spiegeleisen were completely dissolved in hydrochloric acid, diluted, and a current of sulphuretted hydrogen passed through the liquid. After standing for twelve hours, the solution was filtered and washed with water containing sulphuretted hydrogen; the filtrate was boiled, 10 grs. of potassium chlorate added, the iron separated, and the manganese estimated in the usual manner.

The following experiments were tried to test the accuracy of this method:—

(1). The manganese was estimated after separation of copper as above; gave 2·380 grs. of Mn_3O_4 = 8·57 per cent of manganese.

(2). The manganese estimated as usual after separation of iron only, gave 2·457 grs. of Mn_3O_4 = 8·85 per cent of manganese.

The copper was estimated in this precipitate by precipitation on a platinum crucible by zinc; gave 0·074 gr. of Cu = 0·093 gr. of CuO. Subtracting from the original weight, leaves 2·364 grs. of Mn_3O_4 = 8·52 per cent of manganese.

Two experiments similarly conducted gave—

(1). Mn_3O_4 = 2·375 grs. = 8·55 per cent of manganese.

(2). Mn_3O_4 (+ CuO) = 2·459 grs. = 8·86 per cent of manganese. Cu = 0·077 gr., equivalent to 0·096 of CuO. Subtracting, leaves Mn_3O_4 = 2·363 grs. = 8·51 per cent of of manganese.

These results may be thus tabulated:—

Manganese by	1st expt.	and expt.
Usual method	8·85 ..	8·86
After subtracting CuO ..	8·52 ..	8·51
Previous separation of Cu..	8·57 ..	8·55

In each of the experiments marked (1), a trace of copper escaped separation and could be detected in the ignited proto-sesquioxide.

If the method used be that of determining the copper in the precipitate, the estimation must be made with the greatest care, on account of the small quantity of copper present; the solution must be decanted immediately the zinc is completely dissolved, and excess of acid must be carefully avoided, otherwise the film of copper will partially re-dissolve.

It is evident that, if the precipitation be effected by ammonium sulphide or sodium carbonate, separation or estimation of the copper is likewise necessary.

Dr. Wolcott Gibbs proposed to precipitate manganese as ammonio-phosphate, weighing as pyrophosphate. This method gives very accurate results in pure solutions of manganese, but, in spite of every precaution, a minute amount of copper is dragged down with the precipitate in the presence of that element; it is also liable to the objection that calcium, magnesium, &c., when present, would also be precipitated.

The accurate determination of manganese in spiegeleisen is of importance commercially; as, being the most important constituent, the value of the material is frequently judged by the percentage of that element alone, while the error introduced by the presence of copper is aggravated by the fact that, not only is copper worthless, but absolutely injurious.

The combining proportions used were—Mn, 55; Cu, 63·4; O, 16.

ON ALUMINIUM WEIGHTS.

By Dr. T. L. PHIPSON, F.C.S.

FOR the last ten years—that is, since May, 1860—I have made use of a set of aluminium (division of the gramme) weights. On the average these weights have been used at least twice or three times a-day for a period of somewhat more than ten years. They were supplied by MM. Collot, Frères, of Paris. Latterly, I have tested them and found them as accurate as the day on which they were first used. They are almost as brilliant as when new. The larger weights 0·5, 0·2, and 0·1 gramme show slight traces of tarnish, but their weights are still quite accurate.

During this period of ten years these weights have never been touched except by a pair of soft brass nippers, and they have never been left exposed to the air for more than a few minutes at a time. However, they have, of course, been exposed for a minute or two at intervals to an atmosphere more or less impregnated with acid or alkaline vapours, and if we add these odd minutes together, it will be found that these gramme divisions in aluminium have had to undergo a considerable amount of "atmospheric influence" during the period of which I speak.

I need scarcely say what a luxury it is to use such large weights as these in comparison to the platinum gramme divisions, and I am surprised that they are not more generally adopted in our laboratories. The set contains 14 weights, from ½ a gramme to ½ a miligramme. As to brass or copper divisions, I have always considered them inaccurate, for they tarnish very rapidly in an atmosphere which, for that of a laboratory, might be considered tolerably pure. Weights of maillechort (a kind of German silver) resist much better than copper or brass weights; I have a set since the year 1856, the gramme divisions of which extend only to the centigramme, and are perfectly bright and accurate at the present day, but they have only been used occasionally.

The Cedars, Putney, S.W.
October 10th, 1870.

EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.*

By FRANK H. STORER,
Professor in Massachusetts Institute of Technology.

(Continued from p. 163).

EXPERIMENT V.—*Determination of Lime in Marble.*

REDUCE a quantity of pure white marble to fine powder and dry it upon a water bath. Weigh out 3 or 4 grms. of the powder, place it in a beaker of about 700 c.c. capacity, and pour upon it 40 or 50 c.c. of water. Cover the beaker with a glass plate and add dilute chlorhydric acid, little by little, to the water, until the whole of the marble has dissolved. About 100 c.c. of the acid may be required to effect the solution. As soon as the marble has dissolved, fill the beaker half-full of water and boil the mixture. Add a solution of oxalate of ammonium in slight excess, together with enough ammonia water to make the mixture alkaline. Leave the mixture at rest for twelve hours or more, then transfer the clear supernatant fluid to a six-inch filter, and wash the precipitate in the beaker, four or five times, by decantation. Finally, transfer the precipitate to the filter, and wash and dry in the usual way. Heat the precipitate in a porcelain crucible for fifteen minutes to a temperature just below redness, in order to convert the oxalate to carbonate of calcium. If the material analysed were absolutely pure, and the work entirely accurate, the final weight of carbonate of calcium obtained would of course be identical with the weight of marble taken.

Since it is difficult to convert oxalate of calcium to the condition of carbonate, by ignition, without decomposing a portion of the latter, it is well to moisten the ignited precipitate (after it has been cooled and weighed) with a solution of carbonate of ammonium, to dry the mixture, first upon a water bath, and then over the lamp at a gentle heat, and again weigh it. This last weight will give the true amount of carbonate of calcium.

In our experiment 3·101 grms. of marble were taken, and 3·0975 grms. of carbonate of calcium were found. 3·0975 grms. of CaO,CO_2 represent 1·734 grms. of CaO. Hence we found 55·93 per cent of lime, instead of the 56·00 per cent required by theory.

Numerous forms of apparatus for determining the proportion of carbonic acid in limestone will be found figured in works relating to quantitative analysis.

(To be continued).

* Communicated by the Author. From the *Massachusett's Teacher*.

NOTICES OF BOOKS.

The Natural History of Commerce, with a Copious List of Commercial Terms and their Synonyms in Several Languages. By JOHN YEATS, LL.D., Fellow of the Geological Society of London; of the Royal Geographical Society; Member of the Society of Arts, &c. Assisted by several scientific gentlemen. London and New York: Cassell, Petter, and Galpin. 1870.

THE work before us, the first of a series, is one which we hope will be gladly welcomed and largely perused by those who must almost daily feel the want of a book of this nature. Undoubtedly there is a want of such books in the United Kingdom, and its merchants and manufacturers have reason to be indebted to the author, who in this volume delineates the principal divisions of the earth from an industrial point of view, and describes the varied contents of the inorganic and organic world—that is to say, the raw materials of commerce, according to their material value and importance. The book therefore comprises the geography and natural history of raw materials—the contents of that vast storehouse, the world at large, which ought to be familiar to all civilised men, and especially so to the mercantile classes of this country. The first part of the work contains—The Geography of the Home Country, the adjacent Continent, our Colonial Dependencies and Foreign Trade Connections. This first portion is subdivided into twelve chapters, viz.:—Raw Material; Our National Home; Geology of Great Britain; The United Kingdom—Ireland; The United Kingdom—Great Britain; British Fisheries; European Analogues of United Kingdom; the British Empire; British Colonies and Possessions; Foreign Produce—Europe; Asia; the New World; Nature and Man as Agents of Change. Part the second contains—The Commercial Products of the Vegetable Kingdom, subdivided into food plants, industrial, and medicinal plants. Part three—The Commercial Products of the Animal Kingdom, subdivided as follows:—Introduction; products of the class *Mammalia*; products of the class *Aves*; products of the class *Reptilia*; products of the class *Amphibia*; products of the class *Pisces*; products of the sub-kingdom *Mollusca*; products of the sub-kingdom *Annulosa*; products of the sub-kingdom *Radiata*; products of the sub-kingdom *Protozoa*. Part four—Raw Mineral Produce; subdivided into metals and minerals proper. The appendix contains—Vocabulary of the Names of Natural Productions in the principal European and Oriental Languages. Valuable as are the contents of the work, that value is largely increased by the addition of this excellent and very complete vocabulary, and for that alone the work should find a permanent place in mercantile offices among dictionaries of commerce and directories. Lastly, we have, illustrated by an excellent coloured frontispiece—The Geographical Distribution of Food and Industrial Plants.

It is a stigma to our days that works of this kind are not valued as they should be, while books of fiction and sentimental rubbish (partly the effect and partly the cause of an excitable nervous system) are read and bought with avidity. We therefore congratulate the author as well as the publishers for having the courage to undertake the issuing of such a work as this, which, moreover, has the merit of being written with brevity as well as accuracy, and is issued at a price which renders its acquisition by the many easy.

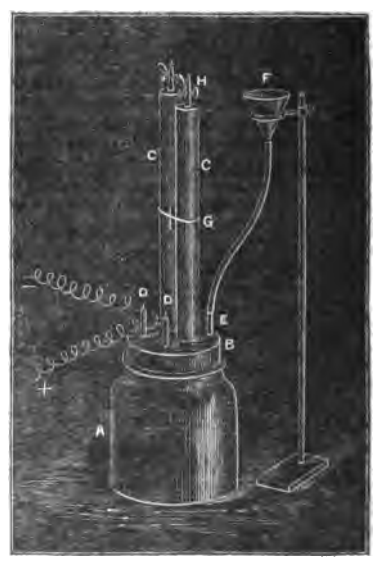
We have perused this volume with great pleasure; it supplies a want which those who are acquainted with the German and French works on what is characteristically called in German, "Waaren-Kunde," will best understand. This volume will be followed by two others from the same author's hand. The first, entitled "The Industrial and Political History of Commerce," will dwell upon the development and decay of the several nations that have successively taken a lead in arts rather than in arms; in it the uses and abuses of *Capital* will be chiefly considered, and the question submitted, Whether, notwithstanding serious lapses, mankind does not, as a whole, progress, and whether we may not speak of past ages as of wheat-ears, and say of them, they "ripen and die, yet live?" The third volume will have for its title, "The Technical History of Commerce," and will consist of a series of sketches on the growth of the industrial *Arts*, *not* of processes, which would lead into technology. It will deal with *Labour* principally, and the object is to show the heritage of wealth, both intellectual and material, enjoyed by the workman of the present day; it will contrast his position with that of any of his predecessors, and point out his duties to his fellow man as well as his obligations to posterity.

LABORATORY NOTES.

ON A CHEAP FORM OF VOLTAIC DECOMPOSITION APPARATUS.

THE decomposition tube, devised, I believe, by Dr. Hofmann, and described at p. 50 of his "Modern Chemistry," is an extremely elegant and luxurious piece of apparatus for showing analysis of bodies by electricity; but it has two defects, viz., that it is expensive to begin with, and very easily broken, either during its carriage, or by the mischances of the laboratory assistant. Experience of the fragile character of these tubes led me to make a more substantial apparatus, which, while it has the advantage of the ordinary tube, can be fitted up in any laboratory for a few shillings. The following is a description of the arrangement:—

A is a common pomade bottle, into which is fitted an india-rubber stopper, B, perforated with five holes (two



large, two small, and one medium size). Though the two large holes of the stopper pass two glass tubes, c c, of about ½-inch diameter and 7 or 8 inches length. Each of these tubes is closed at the top by an india-rubber stopper carrying a piece of ¼-inch glass tube, to which is attached a jet and pinch-cock, H. The electrodes are made as follows:—A piece of thick platinum wire is beaten out at one end to form a flat plate, and is then threaded through a piece of glass tubing rather shorter than itself. When this is done, the glass is melted on to the platinum, and the tube, with its contained wire, is bent in the form of

the letter J. A second piece of wire and tube is treated similarly to form the second electrode. When these are made, they are passed through the two small holes of the stopper, B, and project above it, as represented at D D. The electrodes are turned so that they may pass up into the tubes, C C. To the remaining hole of the stopper is fitted a tube, E, connected by a piece of caoutchouc tubing with a funnel, F, supported on the ring of a retort stand. The apparatus is now complete, and when the stopper with its appendages is fitted into the pomade bottle, is all ready for charging. This is done by pouring the acidulated water or other electrolyte into the funnel, F, at the same time opening the pinch-cocks to allow the air to escape. When the bottle and tubes are full, the pinch-cocks are closed, and all is ready for attaching the battery to the electrodes at D D. I omitted to mention that the tubes, C C, may be conveniently steadied, should this be necessary, by tying them against a cork wedge, as represented at G.

C. J. WOODWARD, B.Sc.

Midland Institute, Birmingham,
October, 1870.

OBITUARY.

AUGUSTUS MATTHIESSEN,

Who died last week, on the 6th of October, was born January 2nd, 1831, in London. He studied in Heidelberg, under Bunsen and Kirchhoff, and worked both in the chemical and physical laboratories.

His first piece of chemical work was published in the *Journal of the Chemical Society*, in the year 1856, under the title "On the Preparation of the Metals of the Alkalies and Alkaline Earths by Electrolysis." This research, a continuation of Bunsen's work on the subject, was carried out in Heidelberg, under Bunsen's inspection, and was crowned with success. The metals of the alkali-earths were then, for the first time, isolated and shown to be possessed of rather unexpected properties—calcium, for instance, being found to be a yellow metal particularly ductile and malleable, and having about the same degree of hardness as gold. It was shown that, although calcium is electro-negative to potassium and sodium (water being the exciting fluid), yet neither potassium nor sodium is capable of reducing chloride of calcium at high temperatures, and, therefore, that which had been described by other chemists as calcium obtained by such a process could not be the metal in question.

An extraordinary degree of manipulative skill was displayed in this investigation: and yet Matthiessen laboured under the physical difficulty of unsteadiness of hand (specially of the right hand), and in consequence of it wrote a most desperate kind of handwriting, as his friends can testify. He was, later in life, induced to give up writing with the right hand altogether, and to take to writing with the left.

Two other notices on the same subjects, viz.:—"On the Preparation of Strontium and Magnesium," and "On Barium," also occur in the same volume of the journal. An interesting fact brought to light in the former of these notices is that calcium is electro-positive to strontium (water being the exciting fluid). The note on barium, was to the effect that that metal could not be obtained as a regulus by the process which furnished buttons of calcium or strontium.

In the following year (1857), Kirchhoff communicated to *Poggendorff's Annalen*, a paper in Matthiessen's name, entitled "On the Electric Conductivity of Potassium, Sodium, Lithium, Magnesium, Calcium, and Strontium," and embodying the experimental results obtained by Matthiessen in the physical laboratory in Heidelberg.

From this paper it appears that, whilst Becquerel had found the ratio of conductivity between potassium and silver to be 1·7 : 100, Matthiessen found it 22·6 : 100, both being observed at the same temperature, viz., 0° C. The device now so well known, of pressing out small portions of metal into thin wire by means of a steel press is also described in this paper. Matthiessen even managed to press out such substances as tellurium, bismuth, and antimony into thin wires, admirably adapted for physical determinations of various kinds.

Poggendorff's Annalen for 1858 contains two memoirs of Matthiessen's, viz., "On the Electric Conductivity of Metals," and "On the Thermo-Electric Series." In the *Philosophical Magazine* for the same year, Matthiessen had a paper "On the Coercitative Power of Pure Iron." About this time he returned to London, where he remained almost uninteruptedly till the end of his life.

In 1862 he was appointed to the chemical lectureship at the medical school of St. Mary's Hospital, and about the same period became a Fellow of the Royal Society. In 1869, he removed from St. Mary's to St. Bartholomew's Hospital, and, in the same year, the Royal Society awarded to him a Royal Medal, in acknowledgment of his researches. The physico-chemical work on metals, which, as has been said, was published in the years 1857 and 1858, was continued for a number of years, and published in a series of papers in the *Transactions of the Royal Society*.

Matthiessen also turned his attention to one of the departments of organic chemistry, viz., the chemistry of the opium-bases, which he investigated with conspicuous success. By exposing narcotine to the action of hydriodic acid, he and Mr. Foster obtained iodide of methyl in large quantities, and, as will be learnt on referring to their paper, actually attained to a knowledge of the structure of narcotine, which now awaits confirmation by synthetical methods.

The more recent work on morphia and codeia is fresh in the recollection of chemists. Some of it was done single-handed, and some with the co-operation of Mr. Wright. To medicine it has yielded apomorphia, a new agent in therapeutics. What further was in store is now withheld.

There is a fatality attending English official chemistry. Within the month one chemist has been stricken with acute mania, and next the epidemic seized upon poor Matthiessen, whom, in the dearth of English workers, we could so ill afford to lose. Overshadowed by a dark cloud, he poisoned himself with prussic acid.

J. A. W.

CORRESPONDENCE.

THE LATE DR. MILLER.

To the Editor of the Chemical News.

SIR,—May I suggest to yourself, and (through your kind intervention) to the scientific world, the desirability of honouring the memory of William Allen Miller, whose loss you feelingly communicate to your readers, by some permanent memento.

He had a diversity of claims upon our respect which render the combined action of his admirers more likely to effectuate good out of evil than happens in the case of every deceased philosopher.

A copious writer, an original observer, an experienced metropolitan lecturer, a conspicuous office-bearer in leading scientific societies, a graduate of London, Edinburgh, Cambridge, and Oxford, few men within the latter half of the 19th century have been better known (at least by name) to British students of nature, and fewer still equally valued for their personal amiabilities.

I would propose, therefore, with your favouring co-operation, and that of other leading English experimentalists, that we should raise, by subscription, a fund (to be vested in the Royal or Chemical Society, or in King's

College), the interest of which should annually be expended in gold or silver medals, or the like, to be openly awarded to youthful chemists who shall produce the best original memoirs on that branch of science dear to our deceased friend, the medals, in their style and impress, commemorating his worth as well as the investigator's merit.

I need hardly presume to say that to such a movement I should be glad to contribute my small quota of time and money, if emanating from any person more entitled to the consideration of chemists than—Your obedient servant,

B. W. Gibsone, B.Sc.

Eaton Square, S.W.
October 10th, 1870.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

The American Journal of Science and Arts, September, 1870.

This number opens with the announcement that a third series of this periodical, originally started in 1818, will be commenced on the 1st of January next, and the issue will then become monthly. The following original papers and memoirs relate to physico-chemical and collateral sciences:—

Atomic Volumes of Solid Compounds.—F. Wigglesworth Clarke.—This lengthy memoir, full of cyphers and formulæ, winds up as follows:—Now to sum up the important relations traced in this paper, bearing in mind that, in many cases, exceptions exist—(1) When similar metals have equal atomic volumes, those of their similar compounds will also be equal; (2) metals whose atomic volumes are unequal, but simply related to one another, often form similar compounds having equal values; (3) some compounds have atomic volumes which stand in very simple relations to the sums of those of the free elements which form them; (4) compounds formed by the union of similar elements have atomic volumes which are multiples of the lowest for that group; (5) we may add the multiple relations traced in my former papers, which not only connect the atomic volumes of different elements but the various values for each single element. May we not say, the author proceeds, that, in all compounds, the atomic volume of every element will be either a perfect multiple of the lowest value for that element, or of the lowest value in the group to which it belongs? Although this theory cannot be regarded as entirely proved, it certainly possesses a considerable degree of probability, and seems to harmonise well with the regularities which I have pointed out; but why an element should have a higher value in one compound than in another remains to be accounted for, although upon this point, perhaps, Dr. Buff's idea, that the different degrees of quantivalence of an element in its various compounds cause the difference in its atomic volumes, may prove correct. But, at all events, whether the theory I put forward turns out true or false, it may, perhaps, by lending some system to the study of atomic volume, pave the way for something of greater value.

Researches in Electro-Magnetism.—Dr. A. M. Mayer.—This lengthy memoir, illustrated by a series of woodcuts, contains an exhaustive account of a series of more than thirty experiments, made with the view to ascertain the relative forces of two electro-magnetic cores—one composed of *insulated* wires; the other, of the same number of similar wires, *uninsulated*.

Precipitation and Determination of the Metals of the Magnesium Group in the form of Oxalates.—W. Gould Leison.—Reserved for reproduction in full.

New Analytical Process.—J. H. Talbott.—The process alluded to is the precipitation of zinc from a neutral, or nearly neutral, solution, by the addition of sodic or ammonic sulphide to the boiling zinc-containing solution. An excess of the precipitant is to be avoided; a white granular sulphide of zinc settles rapidly down, and is washed with hot water by Bunsen's method. The sulphide of zinc is partially dried with the filter, brought into a porcelain crucible, and ignited, at first gently, and afterwards strongly, with free access of air. The expulsion of the last traces of sulphuric acid is facilitated by the addition of small fragments of carbonate of ammonia; pure oxide of zinc at last remains. The author states that this method of quantitative estimation of zinc is very correct; manganese may be estimated by a similar process.

Quantitative Separation of Tin and Tungsten.—J. H. Talbott.—The method described by the author is based on the fact that stannic oxide, SnO_2, is reduced by potassic cyanide with great facility; while tungstic acid, WO_3, undergoes no reduction, even when heated with the cyanide at a high temperature. The oxides of tin and tungsten are to be heated in a porcelain crucible with three or four times their weight of commercial potassic cyanide, previously fused, pulverised, and thoroughly mixed with the two oxides. The mass is kept fused for a short time, when the tin separates in the form of metallic globules, while the tungstic acid unites with the alkali of the potassic cyanate and carbonate present. After cooling, the mass is to be treated with hot water, which dissolves the alkaline tungstate and other salts, and leaves the tin as metal; this is to be separated by filtration, washed, dried, and weighed as stannic oxide, after oxidation in the crucible with nitric acid. The tungstic acid may be estimated by difference, or be precipitated by mercurous nitrate after boiling the solution with nitric acid, to decompose the excess of potassic cyanide present, and then re-dissolving the precipitated tungstic acid by means of an alkali. The author quotes some examples of experiments made by him with this method, from which it appears to be very correct. Tin cannot be separated from molybdenum by this process, because molybdic acid is always more or less reduced to a lower oxide.

Treatment of Gelatinous Precipitates.—T. M. Chatard.—After referring to the inconvenience and loss of time familiar to all chemists which attend the washing of all gelatinous precipitates, the author suggests that the solution containing the substances to be determined is to be simply evaporated to perfect dryness (best on a water-bath) with a small excess of the precipitant, and the gelatinous mass stirred with a rod, until it becomes a perfectly dry powder. The author communicates the results of some experiments made by him according to this plan, from which it appears that the accuracy of the analytical results rather gains than loses by this method.

Precipitation of Antimonous Sulphide from Boiling Solutions.—S.P. Sharples.—In order to obtain the precipitate of antimonous sulphide in a granular state, the author employs the following process:—Into the solution containing, as usual, tartaric and free hydrochloric acids, a current of sulphydric acid gas is to be passed; the liquid being, during the passage of the gas, gradually heated to the boiling-point. The boiling is to be continued for fifteen or twenty minutes, the current of the gas passing, uninterruptedly, until the voluminous sulphide has become a dense granular powder occupying but a small portion of the original volume of the sulphide. The precipitate thus obtained may be washed with great facility, and dried at 200°—300°. Arsenous sulphide does not become granular and dense under the same conditions. The author incidentally observes that the sulphides of nickel and cobalt, when thrown down from boiling solutions, should be filtered off and washed immediately after precipitation; in this manner, there is no oxidation upon the filter, even during the drying of the precipitate.

Introduction of the Principle of Repetition into Chemical Analysis.—Bryant Godwin.—What the author desires should be done is best elucidated by the instance quoted by him at some length—When iron is determined by means of potassic permanganate, all the iron is, at the end of the operation, in the form of sesquioxide, while there is also a very small excess of unreduced permanganate. When the solution is boiled for a short time with pure zinc-dust, and rapidly filtered and washed with water (previously boiled to expel air), the iron is left as ferrous oxide, and the process of titration may be repeated a second, and even many more times, until the bulk of the liquid becomes too large to handle. The author quotes the results of a series of analyses made in this way; which serve to show that, with more practice and experience, the principle at least holds good, since, in one case, five repeated titrations gave 14·31 per cent of iron; and, in another case, seven successive titrations gave 14·23 per cent, while the formula required 14·27 per cent.

Pure Scarlet.—W. H. Dall.—The author, in a letter to Professor Silliman, states that, in 1863, while engaged in making anatomical drawings from living microscopic animals, he purchased, among other colours (water colours), a cake (made by Winsor and Newton, of England) stamped "pure scarlet"; it was, indeed, the finest and most vivid scarlet—far superior in brilliancy to any of the various shades of vermillion which are commonly sold. The author further states that he had no occasion to use the colour until 1865, and, later, in 1866 and 1869. The objects coloured with this colour were found to fade very rapidly; and, in one instance, a valuable drawing was lost by the complete fading of this colour, which had been applied for scientific purposes. On examination of the substance, it (the cake of colour) was found to be soluble in iodide of ammonium and hyposulphite of soda; and, with nitrate of silver solution, iodide of silver was produced. The author supposed that the colour was acted upon by hyposulphite of soda, present in the paper; but this supposition is doubtful, considering that three kinds of paper (one of them made expressly for water-colour drawing) gave the same result. Professor Silliman states, in a foot-note, that he tested the small sample of colour sent him, and found it to be *mercuric iodide*, well known to chemists as very volatile, changing, at a gentle heat, from scarlet to nearly white, and the latter returning again to scarlet by friction. Since this exceedingly attractive pigment is liable to be used by naturalists in valuable drawings, it may not be out of place to call their attention to its ephemeral properties.

Bulletin Mensuel de la Société Chimique de Paris (double number) September and October, 1870.

From the *procès verbaux* of the two latest meetings held by this Society, we quote the following particulars:—

Researches on Albumen.—Dr. Gautier.—The albumen present in the so-called white of eggs consists of two different modifications of that substance; one of these bodies is coagulated at 63°, the other at

74°; they are present in the white of eggs in the proportion of 1 to 5. The rotatory power of the first is 43·2°; that of the second, about 26°. White of eggs contains, moreover, a caseine-like matter, and lactoproteine. When white of eggs is treated with water at 15° (that is to say, is kept under water) for six months, in such a manner as to prevent its putrefaction, it becomes partly incoagulable, while the products formed by this reaction differ from those which are formed at 150°, since the pure albumens obtained by dialysis yield, at that temperature, a soluble and insoluble portion, containing—(1) A substance resembling caseine; (2) a substance precipitable by acetate of copper, and analogous to hypoxanthine; (3) a residue partly soluble in alcohol, which, by the aid of corrosive sublimate and basic acetate of lead, are split up into various other albumenoid bodies.

Phospho-Platinic Compounds.—Dr. P. Schützenberger.—When the compound $PCl_3.PtCl_3$ is treated with alcohol, there is formed $P(C_2H_5O)3PtCl_2$, a crystalline body soluble in alcohol and in dilute hydrochloric acid. This substance plays the part of a diatomic radical, the trioxethyl-phosphoplatine. The different salts of this radical are obtained by means of double decomposition between a silver-salt and the alcoholic solution of the chloride. Baryta converts this chloride into a black compound, which is the hydrate of the radical, which latter is obtained in the shape of a black viscous mass, by the action of zinc upon the alcoholic solution of the chloride. The radical combines with chlorine directly, the result being the reproduction of the chloride. The chloride of trioxamyl-phospho-platine is obtained as the chloride just alluded to, simply by replacing the hydride of amyl for alcohol. The compound $P_2Cl_5PtCl_3$, formed by the action of PCl_3 upon PCl_3PtCl_3 yields, with water and with alcohol, hexatomic derivatives.

Chlorhydride of Cyanogen.—Dr. A. Henniger.—The speaker stated, in reference to the fact that MM. Naumann and E. Vogt have proved, recently, that the compound 2CyCl.CyH, discovered and described by Dr. A. Wurtz, does not exist as a separate and definite chemical body, has been long since known to Dr. Wurtz; and, as a proof thereof, is quoted a phrase from the "Dictionnaire de Chimie Pure et Appliquée," vol. i., p. 1080, where it reads—"Dr. Wurtz had called chlorhydride of cyanogen a product which he now considers as a mixture, or, at most, an unstable compound of chloride of cyanogen and hydrocyanic acid."

Action of Silver upon Monochlorhydrine.—Dr. Silva states—When monochlorhydrine—

$$C_3H_5\begin{cases}Cl\\OH\\OH\end{cases}$$

is acted upon by very finely-divided metallic silver at 180°, with the view of withdrawing the chlorine, and also to see whether two molecules of the mono-atomic residue—

$$\begin{matrix}CH_2\\CHOH\\CH_2OH\end{matrix}$$

will combine to form erythrite, the reaction appears to be such as theory would lead to expect.

Solubility of Oxygen in Molten Silver.—Dr. P. Schützenberger says that he and M. Grange are engaged in making experiments on the solubility of oxygen in molten silver; and he gave a *vivâ voce* description (not quoted in print) of the apparatus employed.

This number contains, further, the following original papers:—

Preliminary Communication on the Fatty Matters contained in Chyle.—Dr. Dobroslawine.—This portion of the author's labours is devoted to a chemical investigation of the fatty substances present in the chyle taken from the *ductus thoracicus* of cows while the digestion of these animals was in full activity. The chyle, having been dried, was exhausted with ether, by the evaporation of which there was left a brownish-coloured, solid, partly crystalline mass, soluble in warm ether and in boiling alcohol at 95 per cent. The purified fat was found to contain, in 100 parts—Carbon, 75·36; hydrogen, 12·36. When this fatty matter was saponified, by means of an alcoholic solution of caustic potassa, some ammonia was given off. The purified fatty acid was found to yield, on elementary analysis, in 100 parts—Carbon, 75·98; hydrogen, 12·93. Formula, $C_{16}H_{32}O_2$. The author states that, judging from the irregularity of the point of fusion and consolidation, this fatty acid is a mixture of 60 per cent stearic, and 40 per cent palmitic acid. Chyle also contains some oleine.

Spectroscopic Reactions of Sulphur; and on the Flame of Hydrogen.—G. Salet.—In this paper, the continuation of a lengthy memoir on this subject, the author describes some peculiarities of the blue flame of sulphur and some of its compounds. This blue flame is not hotter than red-hot iron, and contains reduced sulphur; but, at the perisphere of the flame, very active oxidation takes place, and sulphuric acid is formed. The author describes, at length, an arrangement to prove this fact; and this same arrangement is suitable to prove, by experiment, that the zone of aqueous vapour which envelops the flame of burning hydrogen, contains nitric acid and deutoxide of hydrogen.

Annalen der Physik und Chemie, von Poggendorff, No. 7, 1870.

This number contains the following original papers and memoirs:—

Change which Radiation of Heat Undergoes by the Roughness of the Surface of Bodies.—G. Magnus.—Illustrated by several engravings.

Specific Gravity of Alcohol and of Mixtures of Alcohol and Water.—Dr. E. H. von Baumhauer.—The contents of this paper are essentially the same as those of the same author's paper quoted in CHEMICAL NEWS, vol. xxii., p. 71.

Passage of Mercury through Glass Capillary Tubes.—E. Warburg.—An algebraico-physical essay, illustrated with woodcuts.

Continued Researches on Liquid Conductors of Electric Currents.—J. W. Müller.—The last instalment of a very exhaustive and lengthy memoir.

Estimation of the Fusion and Solidification Point of Fats and other Substances.—F. Riidorff.—The main point of interest in this paper is that the author proposes that, instead of taking the fusion-point of such substances as fats, fatty acids, wax, paraffin, and the like, it is preferable to determine accurately the point of solidification of these substances, since that point can be determined with far greater accuracy than the fusing-point.

Electromotive Force Developed by the Contact of Divers Metals.—E. Edlund.

Researches on the Properties of the Images Produced by Photographic Lenses.—Dr. H. Vogel.—Illustrated with a series of engravings.

Velocity of Light while Passing through Quartz.—V. Lang.

Specific Heat of Saline Solutions and Mixtures of Liquids.—A. Wüllner.

Melting of Lead-Shot Fired against an Iron Target.—E. Hagenbach.—Illustrated with diagrams.

Experiment on the Simultaneous Boiling of Two Liquids which are not Miscible.—A. Kundt.—The chief point of interest in this paper, wherein the author gives an account of a series of experiments made with water and benzol, water and oil of cloves, water and sulphide of carbon, is, that two liquids, not miscible with each other when in contact, boil at a lower temperature than when the most volatile of these liquids is brought to ebullition by itself.

Microscopically-Small Tridymite.—F. Zirkel.

Acoustical Attraction and Repulsion.—K. H. Schellbach.

Polytechnisches Journal von Dingler, first number for September, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Experiments to Determine the Value of Various Kinds of Oils Used for Machinery.—H. Fischer.—This paper, chiefly filled with tabulated results of experiments, contains the record of trials of various kinds of oils used for the greasing of machinery, in order to determine their fitness.

Manufacture of Coke from Non-Caking Coals.—E. Vériot and T. Appolt.

Contribution to the History and Statistics of the Manufacture of Mineral Oils, Paraffin, and the Distillation of Brown Coals in Saxony.—R. Jacobi.—The contents of this paper, chiefly of local interest, contain a series of tabulated forms, from which it appears that the industry alluded to is very extensive.

Description of a Process by means of which all Printed Matter, Printed Plates, and Lead-Pencil Drawings may be Readily and Rapidly Copied without any Detriment to the Original.—C. Puscher.—This paper, too lengthy for any useful abstraction, contains the description of a process, and the receipts for making the required preparations, by means of which the object above quoted may be effected; but, judging from the description given, the process is rather a complicated affair.

Extract of Madder for Use in Calico-Printing.—P. Schützenberger.—After referring to the history of the preparation and application of extracts of madder, the author chiefly treats on the use of alizarine direct and without any mordant. This alizarine is that which is obtained from so-called green alizarine (prepared from madder-root), by means of petroleum. The success of the direct application of alizarine depends, first, upon the use of a very pure extract of madder; next upon the use of pure acetate of alumina and a proper solvent for the colouring matter, usually strong acetic acid; and, lastly, upon the simultaneous application of certain substances—preparations of tin, fatty acids, certain salts of lime—all of which serve partly to give a certain hygroscopic action, and also to modify the shade of the colour. Pure alizarine yields a brilliant violet, but it has a reddish hue. Unless purpurine is simultaneously present, alizarine does not yield a good red.

Practical Value of the Continuously-Acting Diffusion Apparatus in Beet-Root Sugar Works.—Dr. O. Cech.

New Method for Analysing Milk.—R. Pribram.—This lengthy memoir is illustrated with woodcuts absolutely required to render the contents of the paper understood.

Preparation to render Lead-Pencil Drawings, Tracings, and Writing, and also Charcoal and Chalk Drawings, Fixed.—W. Wolanek.—The author states, that when the paper containing drawings or writings made with lead pencil or charcoal is painted over, on the reverse side (where no writing or drawing exists) with a moderately-strong solution of bleached shellac in alcohol, the drawings or writings made with lead pencil, &c., become thoroughly fixed, so that they cannot be rubbed off.

Poisoning by Dyeing Aniline Black.—A. Dollfus.—The author states that, while two of his workmen were engaged in dyeing cotton yarn in a hot mixture consisting of aniline, hydrochloric and tartaric acids, sulphuret of copper, chlorate of potassa and water, the men

were suddenly seized with severe headache, difficult respiration, tremor and languor, becoming cold and very weak. Properly administered medical aid restored them to health; but the author cannot well account for these symptoms but by assuming them to be due to the volatilisation of some chloride of arsenic, which may have been formed in consequence of some arsenic having been left in the aniline by careless manufacture; unless, indeed, the symptoms are due to the action of the vapours of aniline itself.

Journal für Praktische Chemie, No. 14, 1870.

This number contains the following original papers and memoirs:—

Some New Sulpho-Salts.—R. Schneider.—This paper, the concluding portion of this very lengthy and exhaustive monograph, contains the following chapters:—Sodium platinum-sulpho platinate—

$$Na_2S,Pt''S,Pt''S,Pt''S_2 + Pt'''S_4;$$

potassium platinum-sulpho stannate; sodium platin-sulpho stannate; disodium platin-sulpho platinate; silver platinum-sulpho platinate; thallium platinum-sulpho platinate; copper platinum-sulpho platinate; plumbo platinum-sulpho platinate; mercuro platinum-sulpho platinate, with bichloride of mercury; sulpho potassium-sulpho thallium. Of all these salts, the mode of preparation, composition per cent, and formulæ are given.

Condition of Chemistry in France.—Prof. H. Kolbe.

On Acridine.—C. Græbe and H. Caro.—The authors discovered, while engaged in purifying crude anthracen, a new substance, which, on account of its biting action when brought into contact with the skin, they have called acridine, a colourless crystalline body, fusing at 107°; can be heated to 360° without decomposition; boiling at that temperature; hardly soluble in cold, but more readily so in hot, water; very readily soluble in alcohol and ether. Acridine, $C_{13}H_9N$, is a strong basic body, uniting with acids to form salts which, like the base itself, are very biting and acrid substances.

On Pyren.—C. Græbe.—The substance just named has been found, by the author, among products containing anthacen. Pyren is a solid, crystalline substance, fusing at 142°, readily soluble in boiling alcohol, in benzol, ether, and sulphide of carbon. This body combines with picric acid, forming a peculiarly characteristic red-coloured crystalline compound, $C_8H_{10}+C_6H_2(NO_2)_3OH$. Pyren is also characterised by forming, very readily, various substitution compounds, several of which are described in this paper.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, August, 1870.

The July number of this periodical not having yet arrived, will be quoted afterwards. This number contains the following original papers:—

Stassfurth and its Industry.—J. Wolff.—The town of Stassfurth is situated in Prussia, Regierungsbezirk (County) of Magdeburg. This lengthy paper gives a detailed account of the enormously-extensive beds of salt wrought near and under the town alluded to since the year 1852. The material, known as *Abraum salze* (there is no proper equivalent English word for this substantive, the nearest approach being *residual salts*), contains a mixture of carnallite (chiefly a compound of the joint chlorides of potassium and magnesium with water, and is worked for potassa, since it may contain up to 26·8 per cent of chloride of potassium), kieserite, polyhalite, and, more rarely, tachhydrite, kainite, and sylvine. A new mineral, called Stassfurtite, or boracite, has also been met with; its composition is expressed by $2(3MgO.4BO_3)+MgCl+HO$. Among the products of this district, bromine is one of the chief chemical substances, now manufactured by Dr. Frank to a quantity of from 120 to 150 lbs. per day. The bromine is obtained from the residual mother liquors.

Production of Opium from the Papaver Plants Cultivated in Germany.—E. Schwend.—This paper contains the author's account of a series of practical experiments instituted on a sufficiently large scale. The result is, that 1 hectare of land yields 10 lbs. of opium, and, moreover, 15 cwts. of poppy seed, from which a fatty oil is obtainable. Nothing is stated in reference to the value of this opium—viz., the quantity of morphia contained in it.

Contribution to the History of some of the Alkaloids.—Dr. Th. Husemann.—This first portion of a lengthy monograph treats on the aconite alkaloids, but the subject is chiefly considered pharmacodynamically and toxicologically.

Revue Hebdomadaire de Chimie, September 8, 1870.

Whilst this number has come to hand, several others, published before this date, have not arrived; and most of the other French periodicals are wanting. This may be readily accounted for by the events of the day.

Treatment of Wood in order to make it a Suitable Material for Paper Manufacture.—M. Mène.—The wood, previously reduced to the state of shavings or sawdust, is placed for a time (the duration of which depends upon the nature and state of division of the wood) into water, being left there to rest, as is done with flax. By this treatment, a great many substances are removed from the wood, which is thereby afterwards more readily pulped. The rotting in water has the effect of disintegrating and partly decomposing the nitrogenous and incrusting matter of the wood, which is also afterwards more readily bleached, not becoming yellow by the use of chlorine, as is the case where these matters have been left in the wood. The rotted wood is, previously to any other treatment, thoroughly washed with boiling water and steamed, and next treated with an alkali.

NOTES AND QUERIES.

Carbonic Ether.—I wish to purchase a small quantity of carbonic ether. I have tried most of the houses in London, but without success, and should feel obliged if you could direct me where it is to be obtained. —H. S.

Manufacture of Sulphuric Acid.—Can any of your readers inform the writer what is meant by a new process for economising nitrate of soda in the manufacture of sulphuric acid, called the "oxygenised," or "oxygenising" process?—A MANUFACTURER.

Bleaching Wax.—Will you kindly inform me—(1) The easiest method of bleaching paraffin-wax and bees'-wax, and rendering it transparent. (2) What chemical is used in the transaction, and, likewise, the quantity required to bleach, &c., 1 cwt., and the cost of the same? I have a friend, and he says he can do it in one hour, and render it white and transparent.—F. C. TERRELL.

Hofmann's Violet.—"Querist" wishes to be informed whether the process for the manufacture of Hofmann's violet by aid of the iodides of the alcohol radicals is still worked, and how the iodine is recovered? "Querist" reads, in the "Couleurs d'Aniline" of the "Encyclopédée Roret," that M. Levinstein patented a process, in which he uses nitrate of ethyl instead of iodide. Is this process worked? if not, why?

Starch and Alcohol.—(Reply to "Scioliist.")—As regards the correct composition and atomic weight of starch, it would be almost impossible to quote here more than this: that the formula of the perfectly dry substance is usually taken as $C_{12}H_{10}O_{10}$; and, for all practical purposes, this may answer. The quantity of alcohol obtainable from 100 parts of starch is about 56·78 parts, varying slightly in consequence of the fact that, during the different operations by which alcohol (the ultimate product of the vinous fermentation) is formed, there are generated, in larger or smaller quantities, certain by-products, among which are glycerine and succinic acid. The mode of conducting the operations, as well as the raw material employed, influence, more or less, the quantity of alcohol which 100 parts of starch yield. In practice, on the large scale, the true theoretical quantity cannot be obtained, because it implies perfectly pure materials and a perfect mode of operating, whereby no loss should occur.

Extract of Indigo.—(Reply to "Indigo.")—We do not understand what you mean by "weighting"; but perhaps it may be of use to you to say that a small quantity of glycerine is sometimes added to the substance you allude to. Since the quantity of indigotine present in indigo varies very considerably, it is clear that we cannot tell you what the greatest amount of extract is which can be obtained from 1 lb. of indigo; while, moreover, the quantity obtainable depends upon the proper manipulation in preparing the extract. The best, but also the most troublesome and expensive, method of getting rid of the greenish hue you allude to, is to prepare what is known as refined indigo. Since space forbids us to enter here into further details on this subject, and since you wish for a book which will give you some information, we refer you, for the present, to "Lectures on Coal-Tar Colours and on Recent Improvements and Progress in Dyeing and Calico-Printing," by Dr. F. Crace Calvert (published at Manchester by Palmer and Howe, and at London by Trübner and Co.) There is a large work in the press, by the Editor of this paper, which will contain full and ample details on this subject, so as to enable you to work on the large scale.

TO CORRESPONDENTS.

Z. Y. X.—Replies to querists must be sent in such a form that we can publish them. As we have often stated before, we decline to act as the medium for any secret communications. The proper course is for you to advertise.

Lee and Nightingale.—Mr. Alexander Gordon's paper, on "Lead Poisoning and its Prevention," has not yet been received.

Jonathan Bowen.—Articles, or lectures, on the subject of gases, by Dr. Odling, have frequently appeared in our columns. The notes you speak of have not been published.

Jas. Farie, W. H. Walenn, Dr. Phipson, and P. Holland.—Received.

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ON THE TIME NEEDED FOR THE COMPLETION OF CHEMICAL CHANGE.*

By FERDINAND HURTER, Ph.D.

IT is now nearly seventy years since Berthollet published his Essay on Chemical Statics, a work in which he tried to develop the principles of a then new science—the science of chemical statics.

We have not come very much nearer that final result of all chemical investigation, which Berthollet believed to be the science of chemical statics and mechanics, which would enable us to predict the phenomena from the preceding conditions.

The study of the rational composition of the chemical compounds has absorbed the attention of our eminent chemists so much that the dynamical part of our science has been but little regarded, and even the science of chemical statics is in but an imperfect condition.

Although our literature has augmented to an enormous extent, and although the science of chemistry is, in fact, the history of the force affinity, yet we cannot find means to measure the magnitude of that force. We speak of ferrous oxide, as possessing a greater affinity for oxygen than manganous oxide, but how much greater that affinity is, is as yet unknown.

The magnitude of other forces is measured by the work done in a unit of time, or by the resistance necessary to prevent the force from doing the work.

Now we know that 98 parts of hydric sulphate dissolve 65·4 parts of metallic zinc; this affords, however, no measure for the affinity of hydric sulphate to zinc. A physicist would not be content to know that a certain force may remove or lift a certain weight, but he would inquire, "What time does the force need in order to complete this work?" In the eyes of a physicist, the measure of the force which caused the solution of zinc in hydric sulphate would only be complete if we knew, besides the acting quantities, also the time which the reaction occupies.

These are the reasons which induced me to ascertain the time needed for the completion of chemical reactions.

I will now try to develop a formula which shall express the relation existing between the work done and the time required to do it. Let us take any reaction which occupies considerable time to complete itself—for example, the dissolving action of hydric sulphate on metallic zinc.

Let us, for simplicity's sake, assume a piece of zinc of prismatic form, having a base of 1 centimetre square, to be exposed to the action of sulphuric acid. Let us also suppose the piece of zinc to be protected on all its sides, except its base, against the action of the acid.

In the first particle of time, call it a second, a certain quantity of zinc will be dissolved, and an equivalent quantity of acid neutralised. Assuming that at the beginning of the reaction a quantity W_0 of sulphuric acid was present, we shall at the end of the first second only have a quantity W_1 available for action. In the second particle of time this process will repeat itself, and if we denominate the quantities of sulphuric acid left at the end of the first, second, third, &c., particle of time, with W_1, W_2, W_3, we shall have a decreasing series of numbers, $W_0 \ldots W_1 \ldots \ldots W_2 \ldots \ldots W_n$, representing the decrease of acid in course of time.

The quantities of zinc dissolved in the acid in each second will, of course, be proportional to the quantities of acid neutralised, as well as to the depths of the layers of zinc which disappeared in the consecutive seconds.

If we represent the depth of the various layers with $d_1 \ldots . d_2 \ldots \ldots d_3$, &c., we shall have the proportion—

$$(1.)\quad d_1 : d_2 : d_3 = W_0 - W_1 : W_1 - W_2 : W_2 - W_3.$$

It is, further, clear that the action on the zinc, and, consequently, the depth of the disappearing layer, will be proportional to the number of particles of hydric sulphate, which exercise their influence in each moment on the exposed surface. If the molecular forces do at all act through space, the number of particles of hydric sulphate in the sphere of attraction of the exposed surface must itself be proportional to the whole quantity of acid present. I assume that molecular forces do act through distance, although but a small one. I therefore say that the quantities of zinc dissolved, or the depth of the layers disappearing, are proportional to the quantities of acid present in each moment. Now at the beginning we have the quantity W_0, but at the end of the first second only W_1, of acid exercising their influence. It is clear that we may replace the gradually diminishing force by a constant one acting during the same time, and we may therefore say that—

$$(2.)\quad d_1 : d_2 : d_3 = W_0 + W_1 : W_1 + W_2 : W_2 + W_3.$$

From proportion (1) and (2) we obtain—

$$(3.)\quad \frac{W_0 + W_1}{W_1 + W_2} = \frac{W_0 - W_1}{W_1 - W_2}$$

If we reduce this equation we shall have—

$$W_1^2 = W_0 . W_2.$$

Had we used the more general terms, viz.—

$$W_{n-1}, W_n, W_{(n+1)},$$

we would likewise have obtained—

$$W_n^2 = W_{(n-1)} . W_{(n+1)}.$$

This equation indicates that the series of numbers, representing the decrease of acid in course of time, forms a geometrical progression. I may, consequently, use the laws of geometrical progressions for my further demonstrations.

According to these laws, any one member of a geometrical progression may be calculated if the first member and the second are known. We shall therefore be able to calculate the quantity of acid left at the end of any one second if W_0 and W_1 are given.

The rule by which W_n is found is expressed in the formula—

$$W_n = \left(\frac{W_1}{W_0}\right)^n . W_0$$

or, if we put $a = \frac{W_1}{W_0}$, we have $W_n = a^n . W_0$.

In order to calculate the time necessary for the solution of the whole of the zinc, we have but to choose W_n so that $W_0 - W_n$ is the equivalent quantity of acid to the piece of zinc in question. If we then take the logarithmic form of the last equation, we shall find—

$$n = \frac{\log. W_n - \log. W_0}{\log. a}$$

where n represents the number of seconds necessary to dissolve the whole of the zinc.

Let us now assume that the zinc had another area, larger or smaller than in the previous case—say c centimetres square = A. Then this piece would evidently be equal in its action to c pieces of the former sort. The quantity of acid available for action would decrease more rapidly. Our formula tells us that one piece of zinc is able to reduce the quantity of acid in n seconds from W_0 to $a^n W_0$. If we desire to know the quantity of acid left after n seconds, when c pieces of zinc are acting, we shall have to apply our co-efficient of diminution, a^n, c times, in order to find W_n. We shall therefore have $W_n = a^{n.c} W_0$; or, denoting with A the area of the piece of zinc, $W_n = a^{nA} . W_c$. From this equation we derive the following one:—

$$n = \frac{\log. W_n - \log. W_0}{A \log. a}$$

* Abstract of a paper read before the British Association, Liverpool Meeting, Section B.

From this formula, a great many interesting conclusions may be drawn.

We leave the numerous examples which might be and were produced: we will only cite the most interesting one, in order to prove the truth of the mathematical deductions.

The oxidation of manganous oxide, as carried on on a large scale under the name of "Weldon's process," is a subject with which the British Association is well acquainted. The manganous oxide is suspended as a fine precipitate in an alkaline solution of calcium oxychloride, through which a certain number of air bubbles rise in a given time. The manganous oxide offers an infinite surface to the limited surface of the air bubbles. The manganous oxide represents the sulphuric acid, and the air bubbles the zinc, of the former examples. If we, therefore, apply our formulæ to this example, we shall be able to calculate the quantity of manganous oxide left unoxidised after any period of time, assuming a^A to be given. Now, if the blast-engines supply, in equal periods, equal quantities of air, we may assume a^A to be constant throughout the process. This is, however, not always the case, and it is somewhat difficult, on this account, to find examples which agree perfectly with the formula. The manganous oxide itself seems to exercise different affinities towards oxygen under different conditions of alkalinity. It is, therefore, not to be expected that the results should always agree with the theoretical requirements.

In the works of Messrs. Gaskell, Deacon, and Co. in one case, a quantity of manganous oxide was converted into peroxide amounting to 19 per cent at the end of the first half hour. At the end of the fourth hour it proved, on analysis, that 81 per cent had been converted into binoxide. The question arises, what time would, theoretically, have been necessary to complete the oxidation as far as 81 per cent, if we know that in half an hour 19 per cent have been converted. By applying our formula for the determination of time to this case we arrive at the answer, 3·94 hours.

In another case the amount of peroxide of manganese formed was 58·5 per cent after two hours oxidation; at the end of four hours it amounted to 82 per cent. Our formula requires for that purpose 3·90 hours.

In a third case the amount of converted manganous oxide amounted to 67·4 per cent after three hours oxidation. To the question, how much would have been converted after five hours, our formula would give the answer 84·5 per cent; in reality it amounted to 84·4 per cent.

Gaskell, Deacon, and Co. used for some time only one blast engine. When they tried to use two, it was found that the two engines would do the same work in half the time. These facts clearly prove that the mathematical deductions are a general truth.

It may finally be mentioned, that for experimental researches, intending to obtain real values for the co-efficient a, the formulæ require considerable extension. We have to take notice of the concentration and temperature of the reagents. We cannot experiment on a piece of zinc in the way I indicated, and we have to introduce the surface as a function of time, as it constantly varies. I believe, however, that the co-efficient a will prove a measure for affinity, because it expresses the work done by affinity in the unit of time.

The marvellous relation which Professor Bunsen found to exist between volatility of substances and their molecular weights, and which he found by measuring the time needed for the volatilisation of various compounds, gives me hope that I shall meet in the results of my further studies on this subject that simplicity which generally characterises the laws of nature.*

* When writing this paper I was not perfectly acquainted with the admirable researches of Professor Vernon Harcourt on the same subject. I am glad to find that my results, as far as they go, agree with those previously found by that gentleman.

ALLOYS OF COPPER, TIN, ZINC, AND LEAD, WITH MANGANESE.*

By J. FENWICK ALLEN, F.C.S.

In the year 1826 a spoon, made by Messrs. Zernecke, of Berlin, was analysed, and the alloy was found to be composed of—

Copper	.. ..	57·1 per cent.
Manganese	..	19·7 ,,
Zinc	.. ..	23·2 ,,

This analysis is included in a chapter on Kupfermangan, by Mr. Johann Zenner, in his "Handbuch der Metall Legimngen," published at Quedlinburg.

Berthier produced a large number of alloys of manganese with various metals, and has recorded their principal properties.

Although there is no published account of such experiments, Dr. Percy has informed me, that some years ago he thoroughly investigated the nature of manganese alloys.

There are also specifications of patents, one in the name of Emil Stoehr, dated 1862, the other in the name of Oscar Priegur, dated 1864; both claiming the original discovery of this class of alloy.

Whilst, therefore, the alloys of copper, zinc, and other metals with manganese have been more or less known to the metallurgist for more than forty years; whilst their valuable physical properties have been fully described; whilst, moreover, manganese in its ores almost approaches iron in its abundance and in its cheapness; and, whilst for years being suffered to escape as a waste product from almost every large alkali works, we find the metallurgist has not succeeded in reducing it to serve as widely except when yoked with iron. We now claim for it a nobler affinity and a higher service.

Having had my attention directed to the subject by the late Mr. John Keates, whose name and memory, by those in this locality who leaned to science still are cherished, I have made it my study, and have been enabled to apprehend the causes that have prevented the general application of this most useful class of alloys.

To produce metallic manganese was not from the first attempted; it is with extreme difficulty that even the smallest quantities of this metal can be produced; these few prills were obtained only after the oxide mixed with charcoal had been subjected, in a plumbago crucible, to an intense heat for two or three hours.

From the first also I discarded using any of the ores of manganese, the iron and the silicon completely destroying the value of the product. Having obtained a comparatively pure oxide of manganese, recovered from the still-liquor, and having mixed this with oxide of copper, not metallic copper, together with wood charcoal, all finely ground and intimately mixed, the charge was put into a plumbago crucible, then heated in an air furnace at an intense heat for from three to four hours. It was found when the pot was taken out, that, still suspended in the charcoal, and not run down to the bottom, were innumerable fine shots of a bright white metal; these being separated by washing and placed again in the crucible and heated, fused, I may say easily, into a prill or button covered with a green layer of vitreous slag.

The process was continued until some ingots were produced, and in these experiments were made as to their malleability and ductility. This knife-blade is the first piece that was successfully passed through the rolls.

The alloy was found to be very hard and very brittle when hot, but when cold, although still hard, it rolled with ease and was highly elastic.

The proportions of the alloy were about—

Copper	.. ..	75 per cent.
Manganese	..	25 ,,

* Read before the British Association, Liverpool Meeting, Section B.

When the simple alloy had been produced in sufficient quantities, compound alloys with zinc were tried in various proportions, and these again rolled with complete success.

Certain mixtures of copper, zinc, and manganese possess the advantage both over German silver and yellow metal, that, whereas, the one will only roll cold, and the other hot, the manganese alloy rolls from hot to cold.

The laboratory experiments having been completed, an air furnace was built in which a 100 lb. plumbago crucible was used.

The results were precisely the same as those obtained in the laboratory, only it was found that, by stirring the charge a few minutes before the crucible was taken out of the fire, by far the greater portion of the metal that before was in small fine shot, needing very careful washing, now settled to the bottom of the pot, and could be poured out as a bar or ingot, the slag also melting, and the unconsumed charcoal floating on the top. This experiment was continued until several hundredweights of the alloy were produced, so that it may be subjected to various tests, and also that some approximate estimate of its cost and value might be formed.

As a simple alloy, in which the proportions of manganese ranged from 5 per cent to 30 per cent, it is both malleable and ductile, with a tenacity considerably greater than that of copper.

With zinc a compound alloy very closely resembling some of the qualities, not the best, of German silver is obtained. The alloy of copper and manganese would also combine with tin, lead, and other metals, and from these castings were made which were applied as bearings for machinery.

It was not the nature of the metal in itself that prevented its being widely used; it was its cost. The waste of manganese is very considerable, over 10 per cent remaining unreduced and forming a silicate; the wear and tear of the plumbago pots and the furnace itself incurred a large expense; and in proportion to the quantity of metal produced, the fuel consumed, and the labour expended, were great. The work was, therefore, for a time arrested by an obstacle which not unfrequently bars the path of the inventor. It was, however, now a question of cost, and a firm belief that a material so abundant, and a product so valuable, had a destiny, enabled one to look hopefully on the dilapidated furnace and the unused metal. The waste of manganese in alloys rich in that metal will, we fear, always be considerable; but the value of the raw material would permit some such loss, could the other points be attained; and these, we believe, have to be achieved. These ingots have been produced by heating the mixture of carbonate of manganese with oxide of copper and charcoal in a tolerably large reverberatory furnace, and not in a small and costly pot. The fuel used has been principally the common slack, or small coal of the district, and not coke; the labour has been proportionately reduced; and we believe you have before you a series of alloys that will ere long play no unimportant part in the manufactures of our country.

It behoves one to say that it is the beautiful furnace arrangement of Mr. Siemens that has enabled us to overcome our difficulties. A furnace planned by Mr. Siemens has supplied the intense heat needed, with a non-oxidising flame, in a quiet atmosphere.

It merely remains for me now to place before you the following series of specimens.

1st. Manganese and copper in various proportions from 35 per cent to 5 per cent of iron, as ingot, sheet, or wire.

2nd. Copper, zinc, and manganese, also in different proportions, and in a variety of applications.

3rd. Copper, zinc, manganese, and tin as ingots and as bearing.

4th. Copper, manganese, and tin in several different proportions as bars.

5th. Copper, manganese, and lead.

ON ARTIFICIAL STONE AND VARIOUS KINDS OF SILICA.*

By the Rev. H. HIGHTON, M.A.

SILICA is found in various forms more or less soluble. some kinds can only be united with alkalies in the heat of a glass furnace; other kinds can be dissolved under a high pressure and after a considerable lapse of time by solutions of alkalies; other forms, again, to which the author particularly wished to call attention, can be dissolved under proper precautions even in the cold. Natural silica of this kind was exhibited both from Germany and England. By means of this soluble silica artificial stone can be formed harder than any natural stone except the very hard granites and primitive rocks. The process is as follows:—

A concrete is made with any good hydraulic cement. When this is dry it is steeped in an alkaline solution of silica, in which is placed a quantity of free silica. The following chemical process then takes place:—The lime in the concrete extracts the silica from the solution, leaving the alkali free, which immediately attacks the free silica and conveys it in its turn to the concrete. This process goes on continually till the lime in the concrete is saturated with silica. By this process, within a week the strength of the concrete is increased from 50 to 150 per cent, and by a longer continuation of the steeping the strength is still more increased.

As the alkali acts only as a carrier of the silica, it is used over and over again; and it is in this that the economy of the manufacture consists.

The following is the comparative resistance to a crushing force of several kinds of stone:–

	Per sq. inch. lbs.
The Silicated Concrete, or Patent Victoria Stone	6441
Aberdeen Granite..	7770
Dartmoor Granite..	6993
Peterhead Granite	6216
Yorkshire Landing	5851
Stafford Blue Brick	4032
Portland Stone	2426
Bath Stone	1244

The stone formed in this manner has been tried as a pavement in the busiest part of Cheapside, and in many other parts of London, and for steps, lintels, sills, &c., in many parts both of this kingdom and abroad as well as in India.

The whole of the stone in the new warehouses, 27, St. Mary Axe, is made in this manner.

As a cheap strong stone, when manufactured on a large scale, it is likely to supersede natural stone, except where the latter is very cheap and abundant.

In localities, as on the Thames, where there are facilities for obtaining good hydraulic cement and hard broken stone, it can be manufactured at a much lower cost than Yorkshire or other stone can be procured.

ON THE

ANTISEPTIC TREATMENT OF CONTAGION AS ILLUSTRATIVE OF THE GERM THEORY OF DISEASE.†

By WILLIAM HOPE, V.C.

AT an experimental farm belonging to a company in which I was interested pecuniarily and scientifically, rinderpest broke out in the summer of 1867 among a herd of 260 or 270 cows. I sent for Professor Brown from the

* Abstract of a paper read before the British Association, Liverpool Meeting, Section B.

† Read before the British Association, Liverpool Meeting.

Privy Council, who, after making his inspection, said he had found every symptom of rinderpest except one, and that was one of the later symptoms generally, although not invariably, preceding death, namely ulceration of the mouth. Next the dreaded ulcers appeared, and Professor Brown told me there was no means of cure known to science, that the disease was practically incurable, that in the present instance there was no sober, serious chance of saving a single animal out of the whole herd. At my particular request Professor Brown explained the progress of the disease, and the peculiar difficulties to be encountered.

Immediately afterwards I undertook the treatment of one-half of the animals. I got all the quick-lime I could lay my hands on, with which I formed broad roadways all round the sheds, three or four inches in depth, and placed pyramids of it along the pathways in the sheds, and slaked it *in situ*, until all the animals were coughing and choking to an alarming extent. I then obtained the report of the Royal Commission on the Cattle Plague, and specially studied the experiments made by Mr. Crookes, F.R.S., which chimed in exactly with my own instincts, and his reasoning being logical and scientific he made a disciple of me at once. I therefore telegraphed to Manchester for a barrel of genuine carbolic acid, and determined upon combining the two treatments of liquid diet for the purpose of guarding against the secondary symptoms, with what I might term the chemical treatment recommended by Mr. Crookes. The result was that, while every single animal that I did not take charge of either died or was slaughtered, I succeeded in saving every single animal that I did take charge of; and if you consider the very large scale on which my operations were conducted, the completeness and thoroughness with which the infection had been disseminated throughout the herd, and the fact that rinderpest is the most infectious of all disorders, whether among mankind or the animal creation, known to science, no one can, I think, doubt that the treatment suggested by Mr. Crookes is a radical and complete specific against rinderpest.

What I wish to call the attention of the section to is the fact that I saved the lives of those animals not by any medical treatment, properly so-called, of the animals themselves, but by an unremitting, ceaseless chemical onslaught on the germs of the disease. I argued in my own mind that a theory such as the germ theory of disease could not, in the nature of things, be partially true; it must either be altogether true or altogether false. If true, it was the most hopeful theory that anyone could comfort himself with in face of an outbreak of zymotic disease, because it afforded some firm and sure foundation for treatment. A purely medical treatment, properly so-called, of infectious disease, always has appeared to me, if I may be pardoned for the expression of so heretical an opinion in such orthodox company, to be empirical to the last degree.

It is probable that medicines act physically as well as chemically, but I am not aware that anyone has been able to give a very satisfactory explanation either of the physical or the chemical action of organic medicines, whether exhibited in the human subject or in a lower organism. The chemical action of many inorganic medicines is, no doubt, perfectly understood; but even the administration in the nursery of a home-prescribed dose of rhubarb and magnesia has always seemed to me the height of empiricism, for here the nurse boldly invites the actions of inorganic and of organic substances, although, no doubt, she exhibits her agents with, on the whole, a happy result. But at last we appear to be getting upon some firm scientific footing, for clearly it is more scientific to attack the germs producing disease with a chemical agent whose action is ascertained, than to exhibit in the inside of the patient affected a variety of organic and inorganic substances which can only at best act upon the disease, that is upon the germ, through the secondary agency of the patient himself. Of course in rinderpest, or in any other infectious disease, the disorder may have proceeded too far before the patient is taken in hand to admit of the possibility of a cure, and death may result from a secondary action set up during the progress of the disease, even although the primary cause of the disease —that is, the germs—may have been altogether exterminated. But it has always seemed to me that this case of the chemical treatment of rinderpest upon so large a scale, is one of the most entirely practical proofs of the germ theory of disease that has yet been obtained, and it is for this reason that I have ventured to communicate these details to this section. In doing so I am anxious to explain distinctly what it is that I mean by the words "germ theory of disease," for the words are so often used that many persons attach various meanings to them.

By the "germ theory of disease" I simply mean the process by which an infectious disease having once originated is disseminated and communicated from one subject to another. I do not desire to apply it in any way to the *origin* of such diseases. Probably we shall never know the truth as to their origin, for it is difficult to see how any accurate observations can be conducted upon such a point. I therefore wish Mr. Crookes's chemical treatment for infection, as successfully carried out in the case above described, to be considered as evidence only in favour of the theory that infectious disease is propagated not originated, on what is known as the germ theory. Of the origin of such diseases I will merely say this—that I have the greatest possible difficulty in believing that the germs of Asiatic cholera existed in a passive state from the creation of the world, whenever that may have been—on which point again I would offer no opinion, for I fear that I am getting on dangerous ground—down to the year 1817, when suddenly called into existence by getting into the congenial climate of a Hindoo stomach.

Perhaps I should now communicate a further experiment that circumstances forced upon me in the chemical treatment as disease attacking, as distinguished from medical treatment of the patient attacked, in this next instance, as I am almost afraid to confess, in the human subject. Turning again to the paper from which I read an extract, I will read a prophecy which I was rash enough to publish at the end of it, in, as you will recollect, the month of November, 1867, that similar treatment would, for similar reasons, prove equally successful in diseases attacking human beings. After reading the passage in question, Mr. Hope proceeded to say:—In the spring of the following year, namely, 1868, I returned home late one Saturday evening, and found, to my horror, that my eldest child was laid up with a violent attack of scarlet fever. It so happened that scarlet fever was the disease, of all others, that I most dreaded for children; and this was a violent attack, with acute symptoms both in the throat and of fever. My wife, however, having authorised the exhibition of carbolic acid, and having already isolated the child, I proceeded chemically to attack his enemy, the scarlet fever germs. The first step was to kill the germs which caused the pain in the throat and the difficulty in swallowing. This was effected by a gargle of one part of carbolic acid—I mean of the pure white carbolic acid manufactured by Calvert—to 200 parts of water. The effect was instantaneous, and the result most encouraging. Our efforts were redoubled. We attacked the germs in every direction, and showed them no mercy. Cloths dipped in a 2 per cent solution of carbolic acid were hung up over the bed and in different parts of the room. The same 2 per cent solution was sprinkled over the bed clothes and over the carpet and furniture. A basin of the same was always kept at the door of the dressing-room, through which alone ingress and egress were permitted, so that the few persons allowed to come into the room might wash their hands in it before going to other parts of the house. During all Sunday and all Sunday night the same treatment was incessantly kept up, and the patient took occasionally small sips of a solution

as weak as 0·2 to 0·3 per cent, and the poor germs of the scarlet fever could not get any rest, and could find no place of security. The result was that when the Monday morning came, the patient was fast approaching convalescence. I should mention that some very simple febrifuges had been given to the patient in addition to the carbolic acid which had been administered to the disease. I have not preserved a record of how these were given, but I am quite sure that if I had there is no one in this room who would say that they were sufficient by themselves to cure a bad case of scarlet fever. Convalescence proceeded most satisfactorily. When the peeling stage arrived, the entire skin of the child was washed all over from time to time with a 1 per cent solution of carbolic acid, and he eventually made a perfect recovery without a relapse, and without any of those dreaded after-consequences which are so disastrous in many cases. Before, however, he could have been certified as safe for other children to approach, some members of the household displayed a somewhat rebellious spirit towards the restrictions imposed on communication with the invalid; and on my return from London one evening I was shocked to learn from my wife, who understood the danger, that several such visits had been paid to the patient when she was off sentry. Up to that time—the patient having been at once isolated, and rigorous measures of disinfection carried out all through the house, as well as in the sick room—the infection had not spread. But I said at once that all our previous care was now thrown away; and it proved to be the case, as in a few days the other children were all attacked also. But the enemy being in their case fiercely assaulted by carbolic acid on his very first appearance, their cases were much milder than the first attack. In the case of a child of about one year old, the carbolic acid was applied to his throat by the steam of hot water, which he was made to inhale, in every instance with the happiest effect. Eventually the disease was entirely burnt out; the recoveries were in each case most satisfactory, and in no case were there any bad after results. This instance by itself would not, of course, carry very much weight, but following a case on so great a scale as that I previously described, and the treatment being the direct consequence of the former, and based upon a distinct and intelligible theory, I have thought that you would consider it also of some interest.

DUST AS A FERMENT.

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A.,
Chemist to the Apothecaries' Hall of Ireland, &c.

THE celebrated lecture and papers upon "Atmospheric Dust," published last year by Professor Tyndall, brought prominently before the public a subject which is intimately connected with the one which I have taken for my text on this occasion, and which for many years I have looked upon as one of our most fertile sources of diseases in large towns, having, in 1866, when the cholera was raging in Dublin, drawn attention to the dangerous character of our street dust.*

It is, however, my intention, in the present paper, to place simply on record some experiments which have been performed from time to time and all bearing upon this most important subject.

Metropolitan towns are unfortunately those which, as a rule, suffer most from zymotic diseases, for the accumulations in a town of importance bring their attendant ills. Every acre of buildings, and every 1000 of increase in population, bring irremovable dirt. The vitiation of localities is not merely a matter of the numerical proportion of the inhabitants, but it becomes changed in character and more dangerous from the destruction of the numerous compensators or renovators provided by nature. The population seek suburban dwellings, and expend fabulous sums in the extra expenses incurred thereby. Those who are forced to remain in the seething mass are, but too frequently, those who suffer most from this dirt, and who, from their careless habits of living tend most towards its advancement.

A good supply of water has been insisted upon for many years, and sanitary measures have been taken in most large towns in regard to this important subject. The gaseous condition of the atmosphere has also received some considerable attention, particularly in connection with the effects produced by manufactories. I cannot help thinking that, as regards epidemic diseases at least, the influence of these sources of contamination has been a little exaggerated, except in the cases of a few of the direct blood-poisoners, such as sulphuretted hydrogen. A most important substance, however, in connection with our sanitary condition, is what has been termed "Atmospheric Dust," or the floating solid constituents of our air. Although well known, it was not much investigated from a scientific point of view in this country until Dr. Tyndall, Professor Lister, and a few others drew attention to it. Tyndall in his experiments has demonstrated, however, one important point, namely, that this atmospheric dust may be viewed as organic matter. But its proximate analysis is one of extreme difficulty, and the researches which have been made in this direction do not throw much light upon the subject. Dr. Angus Smith has, however, with great perseverance, worked out some valuable facts, bearing upon this part of the investigation.

It is evident from the difficulty in giving a critical examination of atmospheric dust that the point of enquiry tends more in the direction of the local pabulum of these particles, and here it may be as well to state that I strictly confine the term atmospheric dust to that dust which floats at a certain altitude, and which has been winnowed from the inorganic particles, except small traces of sodium that are not worth consideration. It is this organic portion that contains the germs which, if not absolutely essential to all changes coming under the names of fermentation and putrefaction, are the prime movers in such phenomena. As Professor Lister says:—"The sporules, besides being produced in incalculable multitudes, are of extreme minuteness, and constitute a very fine dust, which cannot fail to be wafted and extensively diffused through the air." "The particles of dust which are rendered visible to the eye by being illuminated are gross compared with the sporules of a fungus."

As regards much of the pabulum of the atmospheric ferments and the ferment itself, it lies on our shelves, floors, and streets. This is the nest in which germinal matter is fostered and wafted through our atmosphere. Each dust must partake more or less of the local condition of the place.*

The following paper is written with a view to give the analysis of some of this dust, which, to a certain extent, may be considered as typical; also to determine as far as possible their chemical activity as ferments, or their adaptability to become ferments.

Street Dust.

The two following samples were taken from our principal streets, both of which are paved with a very hard and non-absorbent stone.

Grafton Street Dust, dried at 100° C.	
Inorganic matter	68·9
Organic ,, ...	31·1
(Containing nitrogen, 1·07; carbon, 43·7)	
	100·0
Nassau Street.	
Inorganic matter	54·8
Organic ,, ...	45·2
(Containing nitrogen, 2·1; carbon, 57·5)	
	100·0

* *Vide* CHEMICAL NEWS, July 5th, 1867; *Irish Times*, Oct. 9, 1866.

* Dr. Percy says that the Library of the British Museum gives a dust having 50 per cent of organic matter in it. ("Dust and Disease," page 4.)

The organic matter in both these dusts consists of stable manure finely ground; a glass of very low power was all that was necessary to prove this fact, but part of it, from its minute state of division, was evidently very old.

Nassau Street Dust was taken from the locality of a cab stand, and the organic matter was here in an incipient state of change; it exhibited traces of ammonia, whilst these street dusts as a rule generally give, if anything, a slightly acid reaction. Street dust, then, consists of stable manure and stone finely ground; the traffic on the streets supplying the grinding power. On a macadamised road, irrespective of the effects of the traffic, the inorganic matter greatly preponderates, and as it is soil with which the animal matter is attenuated, the mischief is at its minimum. Not so as regards the streets of large municipal boroughs, which are generally paved with a hard stone, which would have no other effect upon this substance than that of an attenuator.

Dust taken from the Top Seats at Merrion Hall, Dublin.

Organic matter	32·1
Inorganic matter	67·9
	100·0

Dust from Gallery of the Theatre Royal, Dublin.

Organic matter	53·2
Inorganic matter	46·8
	100·0

Dust from the Ventilatory Space above the Gas in Ancient Concert Room, Dublin.

Organic matter	35·7
Inorganic matter	64·3
	100·0

These three last specimens as regards general appearance resemble each other considerably. Merrion Hall is the largest place of worship in Dublin, and is comparatively a new building. The other two buildings are much older. The Theatre we presume receives a much greater number of visitors in the course of the tenanted months. All these buildings are well ventilated. The large amount of iron in the dust is peculiar; for instance, that obtained from the Ancient Concert Rooms gave 21 per cent as the amount of peroxide in the inorganic matter.

Dust from the Walls at the Top of Nelson's Pillar, Sackville Street, Dublin.

Organic matter	29·7
Inorganic matter	70·3
	100·0

Height, 134 feet.

This monument is built of granite, and the residue of inorganic matter in this case consisted of mica-felspar, &c. If we take into consideration the position and the difficulty in not detaching a considerable quantity of stone, although a feather was used, the amount of organic matter was truly extraordinary, and if we put it down as containing over 50 per cent of organic matter, as actually contained in the dust if it could have been removed by itself, we shall not be far off the mark.

Some further experiments were then instituted to determine how far, and to what extent, these dusts would operate as ferments, and a volumetric system of measuring the intensity of any process of fermentation was contrived. It enables the operator to watch the process much more definitely than he could by ordinary observation. The process is based upon the reduction of the nitrate of any base to a nitrite in the presence of substances undergoing fermentation. In these experiments the following precautionary measures were adopted, so that, as far as possible, all the fermentations induced were proper to the ferments used in the experiments.

Distilled water was taken and permanganate of potassium added until a distinct red colour remained, it was then distilled, the first portion being rejected. The remainder was then used for the experiments. The ashes of yeast may be employed to supply the mineral ingredients, but in these experiments a mixture of nitrate of potassium, phosphate of sodium, and a little sulphate of potassium and chalk to neutralise the acids formed were employed, the pabulum used being a mixture of cane and milk sugar. The mixtures were well boiled in each experiment in their respective flasks, and after closing with cotton wool and cooling, the ferments were added. They were all placed in a similar position and submitted to a pretty constant temperature night and day, varying from 20° to 28° C.

Expt. 1.—In this case the above mixture, which was found by experience to be one easily convertible into lactate of calcium in the presence of ferments, was submitted for some two to three weeks to the temperature conducive to such changes. It showed no decomposition for fourteen days, but at the expiration of that time there were indications of a fresh molecular arrangement, but no particular development of organisms. This evidently showed that the precautionary method taken for the destruction of the germinal matter had more or less been perfect. The opening and closing of the flask would more than account for the change evinced.

Expt. 2.—In this case ¼ of a grain of nitrate of potassium was used to the fluid ounce of the fermentable mixture. The ferment was the mould of cheese. It was examined from day to day in the following manner:—5 c.c. of the clear liquid were withdrawn with a graduated pipette, and the level of the remaining liquid marked on the flask, so that it can be made up to the original level if there is any loss from evaporation. The 5 c.c. were then mixed with a little mucilage of starch and iodide of potassium added. On acidulating with sulphuric acid, blue iodide of starch was at once formed, representing two N_2O_3 present. A volumetric solution of hyposulphite of sodium was then added until decolourisation of the iodide of starch took place. Each degree of hyposulphite consumed would represent 0·28 of a grain of nitrate as being reduced to nitrite.

	Nitrites.	Nitrates.	Remarks.
After the 1st 24 hours	0·5 hyposulphite consumed.	Present.	Fermenting slowly.
„ 2nd 24 hours	Trace.	Present.	Increased fermentation.
„ 3rd 24 hours	None.	Present.	Vigorous fermentation, thick mycelium, and great quantity of spores

In seven days the liquid had become thick with the mycelium, and crusts of lactate of calcium began to form; in forty-eight hours afterwards the contents of the vessel were solid.

This experiment was repeated again, but with 3 grains of nitrate of potassium to the fluid ounce the results were different, for in this case nitrites were present during the whole of the fermentation. This is rather a curious observation, although the entire of the nitrates was not destroyed; the first instance we had little or no evidence of the nitrous acid. It is probable that in the reduction of the nitrates preparatory to the assimilation of its nitrogen, a nitrite is the first stage, but that if the ferment bears a considerable proportion to the nitrate present, or that the fermentation is going on very rapidly, the nitrogen will be assimilation in the form of some lower compound of nitrogen. There is no evidence of the molecule N_2O_3 during the fermentation, although the supernatant fluid is always slightly acid. One point of importance is evident that, in the examination of potable waters, if no nitrates are present, it is no proof that decomposition is not actually proceeding at the time as regards the organic matter therein.

Expt. 3.—Street dust was allowed to remain some time at a temperature of 20° to 28° C.; it became after a little

while covered with a thick mould. This mould acts as a ferment of great activity when placed in the saccharine mixture described above. After being partially dried it seemed more active, weight for weight, than the mould from rotten cheese.

The following results were obtained on fermenting the usual solutions of sugar, &c., with the addition of 3 grains of nitrate of potassium, and sufficient street dust to represent 1-2000th part of the entire mixture. (In adding this and the other dusts as ferments, only the organic portion was taken into consideration, the weighing being regulated accordingly.)

Days.	Degrees of volumetric solution of hyposulphite of sodium required to decolourise the iodide of starch from the liberated N_2O_3 in 5 c.c.	Remarks.
2	0·3	
3	3·5	Spores, &c., considerably developed.
4	9·5	Fermentation very active; beautiful mass of mycelium.
5	0·8	Fermentation going on very actively.
6	8·5	Fermentation very strong, large quantity of carbonic acid given off, and thick layers of mycelium on the surface.
7, 8, and 9	8·5, 7, and 2·5	Fermentation on the decline.
10 and 11	1	Liquid had become very thick and crusts of lactate of calcium beginning to form.

Expt. 4.—Was a similar examination of the activity of the dust obtained from Nelson's Pillar, a monument in Dublin, 1-2000th part being used.

Days.	Degrees of volumetric solution used	Remarks.
2	3·5	Thick coating of mycelium at once formed.
3 and 4	4 and 7	Fermentation going on vigorously.
6 and 7	8·5 and 8·5	Fermentation seemed upon the decline.
10		Quite solid from lactate of calcium; vessels could be inverted without contents falling out.

Expt. 5.—The dust from the Ancient Concert Rooms was obtained from the ventilating space above the public room. This, it will be remembered, contained a considerable percentage of iron.

Days.	Degrees of volumetric solution.	Remarks.
2	trace of nitrite	No perceptible sign of fermentation.
3	1·0	Slight sign of fermentation.
4	3·5	
5	9·0	
7	10·0	
8 and 9	10·0	Fermentation seemed on the decline.
10	8·5	
12	4·0	Lactate of calcium began to form slowly.

Expts. 6 and 7 were, respectively, with dust from the Theatre Royal and Merrion Hall, Dublin. The first was almost exactly similar to the fifth experiment, but the dust from Merrion Hall approached more nearly to the fourth experiment in its results.

In conclusion, I may remark that, although if I had had time to repeat these experiments, many points in the details of manipulation would have been improved, still the results are of some importance.

They conclusively prove the power of dust as an active ferment.* Also, the estimation of the N_2O_3 as a criterion of the extent, or intensity, of such an action is, I believe, capable of further development. Thus, a slight fermentation that would not probably be perceived could not escape observation by this method. These experiments, as far as they go, seem to point to a curious phase of the subject—that is, that dust taken at a great height, and in such a position as in the fourth experiment, should appear to have as great, or greater, activity than that which would be obtained from a building which is nightly crowded to suffocation. This, in some measure, may be due to the extreme levity of the spores, which are supposed to be the life of the dust, and which lightness may be described as almost approaching volatility. *There is, probably, an altitude of the maximum of activity for all localities as regards dust.* It is so light that even that obtained in an ordinary house contains a large portion that refuses to sink when thrown upon water; and, even when the vessel is placed beneath an air-pump, a large percentage floats. To me the activity of the dust taken from the top of the monument 134 feet high is something marvellous—this source so far removed from the busy streets—yet its organic matter contains what is capable of splitting up, in a short time, hundreds of times its own weight.

I am aware that the results obtained, and detailed in this paper, are not so elaborate as I should wish, but they are experiments in which time is an important item; they are, however, quite sufficient to prove the value of such investigations. Microscopy, at present, is not likely to throw much light upon this subject, except in conjunction with some such work as detailed in the present paper.

SOLAR SPECTROMETRY.

REVERSAL OF THE SODIUM LINES IN THE SPECTRUM OF THE UMBRA OF A LARGE SPOT NEAR THE EASTERN LIMB OF THE SUN.

JUST as we go to press we receive from Prof. Morton a letter with the following important communications by Prof. C. A. Young, which will appear in the next number of the *Journal of the Franklin Institute*. We have not time to get the drawings engraved, but Prof. Young is writing an article of some length, with numerous illustrations, which, through the kindness of Prof. Morton, we hope shortly to give.

Dartmouth College, Hanover, N.H., Sept. 26, 1870.

My dear Sir,—I write to inform you that, last Thursday, September 22nd, about 11 a.m. Hanover mean time, I was so fortunate as to see the sodium lines D_1 and D_2 reversed in the spectrum of the umbra of a large spot near the eastern limb of the sun. At the same time C and F lines were also reversed, but with the great dispersive power of my new spectroscope I see this so often in the solar spots, thar it has ceased to be remarkable. In the umbra of the spot the D_3 line was not visible, but in the penumbra was plainly seen, as a dark shade. I am not aware that this reversal of the sodium lines in a spot spectrum has ever been observed before; its reversal in the spectra of prominences is not very unusual. A small prominence on the western limb of the sun, which was visible the same forenoon, presented all the following bright lines, viz.: C, D_1, D_2, D_3, 1474·, b_1, b_2, b_4, 1989·5, 2001·5, 2031·, F, 2581·5, 2796·, and h; fifteen in all. In the

* If it is required to manufacture butyrate or lactate of calcium practically, I would never advise the use of cheese as a ferment, if any active dust could be got (I do not think there will be any difficulty as regards this point); to get rid of the quantity of extraneous matter which is introduced by the cheese is, however, very frequently very difficult. A little dust, separated from the coarser particles by elutriation, is the correct ferment.

spot spectrum the magnesium lines b_1, b_2, and b_4 were not reversed, but while the shade which accompanies the lines was perceptibly widened, the central black line itself was thinned and lightened.—Yours, &c.,

C. A. Young.

Prof. Henry Morton.

Photographs of Protuberances on the Sun's Limb.

Dartmouth College, Hanover, N.H., Sept. 28, 1870.

My dear Sir,—I write to tell you that this afternoon, with the help of Mr. H. O. Bly, our photographer, who has assisted me in the matter with great skill and interest, I have succeeded in obtaining photographs of protuberances on the sun's limb, of which I enclose a specimen. They were obtained by attaching a small camera to the eye-piece of the telescope and opening the slit somewhat widely. We worked through the hydrogen line near G. As a picture, the little thing amounts to nothing, because the unsteadiness of the air and the mal-adjustment of the polar axis of the equatorial caused the image to shift its place slightly during the long exposure of three and a half minutes which was required, thus destroying all the details. Still, the double-headed form of the prominence is evident, and the possibility of taking photographs of these objects is established. Success will depend upon the use of more sensitive chemicals (those used to-day were such as are ordinarily employed for portraits), and a very careful adjustment of the equatorial axes and the clock-work. I fear a telescope of much larger aperture than mine will also be found necessary, in order to produce pictures that will really give much of an idea of the form and texture of these beautiful clouds. I may add, that between 3·50 and 4·30 o'clock this afternoon the umbra of the spot upon which I made the observation of the sodium lines, as communicated to you a few days ago, reversed the following lines (ranged in order of brightness), viz.: C, F, D_3, 2796 K, (Hyd. γ), b_3, b_1, b_2; D_1, D_2, h, b_4, and 1474 K. The brightness of b_3 was remarkable. Another spot, just south of this nucleus (which was the most southern of four in the same penumbra), also reversed the hydrogen lines very finely, and on opening the slit a little, it was found that the phenomena was caused by two enormous protuberances or luminous clouds, which in the spectroscope shone brightly even upon the surface of the sun. Their form could be distinctly traced—at 4·05 it was as given below: the right-hand one terminated in or close to the nucleus of the spot; the other and larger, in the penumbral region. The whole length in right ascension, determined by the time required for them to pass the slit when the clock work was stopped, was 16·5 secs. of time—a little more than 4′ of arc, or 111,000 miles. They extended from the spot which was nearing the western limb, nearly to the centre of the sun. At five o'clock they were still visible, but much fainter. When brightest I was able to see their form, even through h; the lines other than hydrogen which they showed (notably D_3), were limited to the immediate neighbourhood of the spot group.—Yours truly,

C. A. Young.

Prof. Henry Morton.

NOTICES OF BOOKS.

Annual Report of the American Institute of the City of New York for the Years 1868 *and* 1869. Albany: The Argus Co., Printers.

We owe to the kindness of the Directors of the American Institute the receipt of this large and valuable volume, a tangible proof of the interest taken by the citizens of the great Trans-Atlantic Republic, in science and its useful applications to the various pursuits of daily life. The volume before us, 1125 pp. in octavo, contains:—A review of the operations of the Institute, presented by the Board of Trustees at the annual meeting, held on February 4th, 1869; an exhibit of the receipts and expenditures during the year; the annual reports of the several standing committees of the Institute; twelve scientific lectures delivered at Steinway Hall, in the city of New York, under the auspices of the American Institute; the transactions of the Farmers' Club, including communications from residents of other States; the proceedings of the Polytechnic Association, embracing notes on progress in science and art, both at home and abroad; and, lastly, the discussions of the Photographical Section of the American Institute. As a proof of the excellent arrangement of the Institute, we may state that, among others, it has committees for manufactures and machinery; chemistry, mineralogy, and geology; optical science; civil engineering and architecture; agriculture; horticulture; and commerce. Among the subjects of the lectures given we may notice the following:—"On the Philosophy of the Tea-Kettle," by Prof. Silliman; under this very homely title the eminent *savant* elucidates, in a very clear and precise manner, some of the most interesting facts bearing upon the doctrine of caloric and its application to steam machinery. "On the Telescope," by Prof. Alexander; the lecturer enters into some particulars now rarely, if at all, mentioned, bearing upon the invention of the telescope, which he clearly proves to be due to Hollanders. "On the Philosophy of the Oven," by Prof. Horsford; this lecture contains not only a valuable record of the principles involved in the art of making bread, but also interesting historical and archæological matters. "On the Spectroscope," by Prof. J. T. Cooke; an excellent and very pleasantly written account of the spectroscope and its many applications. "On Modern Engineering," by the Hon. W. J. McAlpine; this paper, although brief, gives a complete review of the subject alluded to. These lectures, although occupying a comparatively small portion of this large volume, are among the most valuable of its contents, and are all and severally models of lectures, as they should be given, to unite the *utile dulci*. It is impossible to give even the briefest review of the varied contents of the rest of this volume, full as it is of useful and valuable information on so great a variety of subjects.. As a work of reference this, the twenty-ninth, Annual Report of the American Institute of the City of New York, will form a valuable addition to European libraries and book-shelves.

CORRESPONDENCE.

PURE SCARLET.

To the Editor of the Chemical News.

Sir,—In this week's Chemical News (No. 568), appears a statement, copied from the *American Journal of Science*, relative to the fugacity of pure scarlet, of which a water-colour cake was purchased, made by the English firm of Messrs. Winsor and Newton. As the paragraph in question may tend to damage their reputation, permit me to observe that every artist knows or ought to know—for a knowledge of the materials of art is by no means universal—that pure scarlet is *the* most fugitive colour in the whole range of artistic pigments. In my edition* of "Field's Chromotography, or Treatise on Colours and Pigments as used by Artists," this colour is noticed as follows:—

"Pure Scarlet, or Iodine Scarlet, is an iodide of mercury, having the body and opacity of vermillion, and being as much inferior to it in permanence as it is superior in brilliancy. Of all artistic pigments it is at once the most dazzling and the most fugitive, and should have no place on the pallette. If used, it should be with an ivory knife, as iron and most metals change it to colours varying from yellow to black; hence it should never be com-

* London: Winsor and Newton, 1869.

pounded with metallic pigments. So sensitive, indeed, is it to the slightest touch of metal, that it has been known to turn to a dull brown merely by being washed over with a colour which had been taken out of its saucer with a penknife. In the cake, it must be carefully kept wrapped up in paper, otherwise the presence of metal tubes or a knife in the colour-box may spoil it. By a foul atmosphere the scarlet is utterly destroyed, and even metallised. In contact with the air it quickly fades away, and has been found to vanish completely when exposed to light alone. Employed in water, a thick glaze of gum-arabic or gamboge adds to its stability. As a landscape pigment, the colour is out of the general scale of nature, but in flower painting its charms are almost irresistible. Nothing, certainly, can approach it as a colour for scarlet geraniums, but its beauty is almost as fleeting as the flowers."

To this let me add, in the words of the same edition, "The palette wants weeding, not only of the bad new colours, but of the bad old colours. This, however, must be a work of time, and depend, not upon the colourman —for where there is a demand there will be a supply— but upon the artists themselves. To this end an increased acquaintance with the properties of pigments is required, whereby they may be able to choose the fast from the fugitive." To enable them to do so forms one of the chief objects of Field's work, and although naturalists, botanists, &c., are not, strictly speaking, artists, yet they so often have occasion to use colours that some knowledge of pigments would save them much trouble and annoyance. Allow me, therefore, to recommend to artistic science and scientific art a perusal of the "Chromotography."—I am, &c.,

THOMAS W. SALTER, F.C.S.

New Wandsworth, S.W.

MISCELLANEOUS.

Church's Laboratory Guide.—We understand that Professor A. H. Church's "Laboratory Guide" will shortly appear in an Italian translation, for use in the agricultural departments of the Royal Institute for Professional Education in the kingdom of Italy.

The Quality of the Gas Supplied to London.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of London and to the Metropolitan Board of Works on the quality of the gas supplied by the Chartered, the Great Central, the City of London, the Imperial, and the South Metropolitan Gas Companies; from which it appears that the average illuminating power of the common gas has ranged from 15·68 standard sperm candles, in the case of the Imperial gas at the testing place at Camden Town, to 18·34 candles in that of the Great Central gas. The average quality of the gas at each of the testing places during the quarter has been as follows:—Great Central gas, at Friendly Place, 18·34 candles. City of London gas, at Cannon Street, 17·37. Chartered gas, at Leadenhall Street, 17·64; at Gray's Inn Lane, 16·93; at Arundell Street, Haymarket, 16·66. Imperial gas, at Chelsea, 16·29; at Camden Town, 15·68. South Metropolitan gas at Peckham, 15·90. The average quality of the Cannel gas has been 25·87 candles in the case of the City Company's gas, and 25·07 in that of the Chartered Company. As regards impurities, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, but that the amount of sulphur in other form than this has fluctuated to a very large extent, for while the average amount of this impurity was only 13·28 grains per 100 cubic feet of the City Company's Cannel gas, it amounted to 34·69 grains per cubic feet of the South Metropolitan gas. The average proportion of sulphur in the gas of each of the companies during the quarter was as follows:—City Company's Cannel gas, 13·28 grains per 100 cubic feet; common gas, 21·84 grains. Great Central gas, 21·19 grains. Chartered gas, at Leadenhall Street, 22·97 grains; at Gray's Inn Lane, 27·87 grains; at Arundell Street, 28·45 grains. Imperial gas at Chelsea, 30·35 grains; at Camden Town, 24·03 grains. South Metropolitan, 34·69 grains. According to Dr. Letheby, these large differences are entirely due to the different processes of manufacture and purification, and they indicate the means of reducing this serious impurity to the smallest amount. Ammonia has not been present in excessive quantity in the gas of any of the companies except the Chartered, and it was only in excess in the gas of that company on the several days from the 12th to the 25th of July last, when it arose from accidental circumstances over which the company had no control.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Chemie und Pharmacie, September, 1870.

This number contains the following original papers and essays:—

On Euxanthon and on Euxanthinic Acid.—A. Baeyer.—The author begins this lengthy memoir with an introduction on the employment of metallic zinc-dust for the purpose of withdrawing oxygen from aromatic compounds, and replacing it by hydrogen. Next, the statement is made that the nature and true constitution of euxanthon, first submitted to research by Dr. Stenhouse and the late Dr. Erdmann, is as yet very obscure. (Euxanthinic acid is a substance present in purrhee, Indian yellow; euxanthon is a derivative of that acid.) The author afterwards describes, at very great length, a series of experiments made with the view to elucidate the constitution, first, of euxanthon, which yields, when fused with caustic potassa, a new body, $C_{12}H_{10}O_3$, euxanthonic acid, distinguished from euxanthon by its far greater solubility in water, from which it crystallises readily. The formula of euxanthon, as originally put forward by Dr. Stenhouse—viz., $C_{12}H_8O_4$—is considered by the author as true and correct, and also agrees with the products of substitution of euxanthon. A second portion of this memoir is devoted to euxanthinic acid, about which we meet with a lengthy discussion regarding the value of the formulæ assigned to this substance by various authors. According to the late Dr. Gerhardt, the formula of this substance is $C_{68}H_{18}O_{32}$; but, from a series of experiments, and from the substitution compounds of this acid, the author deduces the formula $C_{19}H_{16}O_{10}$.

Reduction of Aromatic Hydrocarbons by means of Iodphosphonium.—A. Baeyer.—This lengthy essay begins with a brief review of reduction experiments in general. Next, we meet with a description of a process for the preparation of iodphosphonium:—Dry sulphide of carbon is poured into a tabulated retort, and 100 grms. of phosphorus are dissolved in this liquid, to which, while kept very cold, are added gradually, and in small quantities at a time, 175 grms. of iodine. The sulphide of carbon is next driven off by gentle distillation, and the last traces of that liquid are removed by a current of dry carbonic acid gas, the retort being gently warmed all the while. When this operation has been finished, and the retort has cooled down, there is adapted to the retort, instead of the cooling tube, a rather wide tube, to which is fastened a gas-conducting tube, which ends in a bottle partly filled with water; but the tube should not touch that liquid. This having been done, there is placed in the tubulus of the retort, a funnel, the neck of which is drawn out into a long, narrow point. Through this funnel, a quantity of 50 grms. of water is gradually poured, by small portions at a time (this operation requires great care, since it may readily lead to very serious explosions). After all the water has been added, the retort is heated, at first gently, and at last to dull red heat, whereby the iodphosphonium is driven into the wide tube above spoken of. It condenses in the same, exhibiting a solid body resembling sal-ammoniac. The reaction described is expressed by $P_2I+2H_2O=PH_4I+PO_2$. The author further enters into exhaustive details on the best methods of making iodphosphonium react upon hydrocarbons, and the action of the former body upon benzol, toluol, xylol, mesitylen, naphthaline, and oil of turpentine is described at length.

Researches on the Bases of the Pyridine and Chinolin Series.—A. Bayer.—This monograph is divided into the following

sections:—Synthesis of picoline; preparation of picoline from acroleine ammonia; picoline from tribromallyl.

Aldehyde-Collidine.—E. Ador and A. Bayer.—This paper is really an integral portion of the preceding, but is in the original text under a separate title. Aldehyde-collidine is a body akin to the collidine obtained from Dippel's oil by Dr. Anderson. The authors have divided this paper into the undermentioned sections:—Action of iodethyl upon collidine; by-products of the preparation of collidine.

On Cinchonin-Chinoline.—N. Lubavin.—The author treats on—Sulpho-chinolinic acid, $C_9H_7NSO_3$; tribrom-chinoline. It appears, from the author's researches, that chinoline belongs to the same series of bases as picoline and pyridine; but Dr. Bayer adds, at the end of this paper, that the true constitution of these bodies is as yet undetermined.

Vapour Densities of Acetic Acid.—A. Naumann.—This exhaustive monograph contains, in the tabulated form, the record of the following experiments:—Vapour densities at 78°, 100°, 110°, 120°, 130°, 140°, 150°, 160°, and 185°; vapour densities of acetic acid for equal quantities of acetic acid in the unit of fluid measure; equal vapour densities of acetic acid for variable temperatures and pressures.

Aromatic Glycol.—E. Grimaux.—The author describes—Tollylen-chloride—

$$C_6H_6Cl_2=C_6H_4\begin{cases}CH_2Cl\\CH_2Cl\end{cases}$$

tollylen-bromide, $C_8H_8Br_2$; tollylen-iodide, $C_8H_8I_2$; monobenzoic acid tollylen-ether—

$$C_{15}H_{14}O_2=C_8H_8\begin{cases}OC_7H_5O\\OH\end{cases}$$

deuto-acetic acid tollyl-ether, $C_{12}H_{14}O_4=C_8H_8(C_2H_3O_2)_2$; tollylen-glycol—

$$C_8H_8(OH)_2=C_6H_4\begin{cases}CH_2.OH\\CH_2.OH\end{cases}$$

The Water of the Nile.—O. Popp.—The author states that, while staying in Egypt on a visit, he was requested by a Turkish prince, Halim by name, to make an analysis of the water of this celebrated river, the private chemical laboratory of the prince being placed at his disposal for this purpose. The author's paper opens with some particulars respecting the river Nile, which, from its source to its mouths (there are several), has a direct course of 4200 kilometres, by an average width of from 300 to 400 metres. The mean average temperature of the water of the Nile is only 2° or 3° below the average mean temperature of the air of Egypt. The sample of water taken for analysis was obtained from the middle of the river, some 6 miles below Cairo. Previous to being analysed, the water was left standing for two days, after which time the water was first filtered; but, even after this operation, it did not become quite clear, and it was found necessary, consequently, to leave it standing for some few days longer, when it deposited a flocculent sediment, which, on being tested, was found to consist of silica, a minute quantity of organic matter, lime, and magnesia salts. One litre of the water contains, in grammes' weight—Carbonic acid, 0·03146; sulphuric acid, 0·00390; silica, 0·02010; phosphoric acid, 0·00054; chlorine, 0·00337; peroxide of iron, 0·00316; lime, 0·02220; magnesia, 0·01467; soda, 0·02110; potassa, 0·00468; organic matter, 0·01720;—total, 0·14238 grm. Percentage composition of dry residue—Carbonic acid, 22·155; sulphuric acid, 2·755; silica, 14·150; phosphoric acid, 0·379; chlorine, 2·372; peroxide of iron, 2·227; lime, 15·640; magnesia, 10·332; soda, 14·852; potassa, 3·300; organic matter and small quantity of ammoniacal salts, 12·025;—total, 100·187. Taking into consideration that the quantity of water annually carried by the Nile to sea amounts to 55,000,000,000 of cubic metres (equal to as many tons), some idea can be formed of the quantity of salts, &c., poured by this river into the Mediterranean. The author also analysed the mud and slime deposited from the water of the river; the composition of a sample taken at Soudan was, percentically—Peroxide of iron, 11·95; organic matter, 14·85; lime, 2·64; magnesia, 1·85; soluble silica, 5·50; clay and water, 62·3.

Egyptian Trona.—O. Popp.—The substance known as trona (also named nitrum, although it does not contain even a trace of nitric acid or nitrates) is a native saline produce, a sample of which yielded, on analysis, percentically—Carbonic acid, 33·15; sulphuric acid, 1·65; chlorine, 5·11; soda, 36·34; lime, 0·55; water, 22·50; insoluble matter, 1·65. Equal to—Sesquicarbonate of soda, 64·3; sulphate of soda, 1·5; chloride of sodium, 8·4; sulphate of lime, 1·3; water, 22·5; insoluble matter, 1·65.

Composition of the Excrements of Egyptian Bats.—O. Popp.—After referring to the curious fact that Egypt, owing to its very clear sky at nights, and its sub-tropical climate, is especially suited for bats, of which no less than eight different *genera* are found there, the author proceeds to detail the methods of analysis at length; the result of the composition of the excrements, in 100 parts, being—Urea, 77·80; uric acid, 1·25; kreatine, 2·55; phosphate of soda ($2NaO,HO,PO_5$), 13·45; water driven off at 100°, 3·66; substances insoluble in water, 0·575;—total, 99·285. In a foot-note to this paper, Dr. F. Wöhler states that very recently the excrements of bats from Egypt have become an article of trade, as a sort of guano for manure purposes.

On Ccollpa.—F. Schickendantz.—By the name at the heading is understood (the pronunciation is koichpa) a saline efflorescence, not unfrequently met with in certain parts of the slopes and along the rivers originating in the Cordilleras de los Andes. The author gives, at great length, details of the analysis of several samples of this substance, which, setting aside impurities present only in small quantity, consists, in 100 parts, of—Soda, 45·21; carbonic acid, 28·99; water, 25·70; agreeing nearly with the formula $Na_2C_2O_5+2H_2O$. Another sample consisted mainly of—Water, 35·28; soda, 38·28; carbonic acid, 26·44; nearly agreeing with the formula $Na_2C_2O_5+3H_2O$. The author resides at Pilciao, province of Catamarca, Argentine Republic.

Zeitschrift für Chemie von Beilstein, No. 14, 1870.

This number contains the following original papers:—

Ortho-Nitrotoluol.—F. Beilstein and A. Kuhlberg.—The authors describe—Nitrited aceto-metatoluidine, obtained by treating aceto-metatoluidine with a mixture of 2 parts, by bulk, of very strong fuming nitric acid (the so-called *acidum nitroso-nitricum*), and 1 part, by bulk, of strong nitric acid (sp. gr., 1·475). The product thus obtained is a solid, crystalline body, insoluble in water, soluble in alcohol, and fusing at about 197°. Ortho-nitro-metatoluidine, $C_6H_3(NO_2)O(NH_2)m,CH_3$, prepared from the preceding compound by decomposing it by means of dilute sulphuric acid or alcoholic solution of potassa; a solid yellow-coloured crystalline substance, soluble in alcohol, fusing at about 128°, and yielding no salts with acids.

Chlorinated Para-Chlorobenzoic Acid.—F. Beilstein and A. Kuhlberg.—*p*-chlorobenzoic acid was treated in a sealed tube, at 200°, with 4 molecules of $SbCl_5$; and, after purification of the newly-formed substance, the authors found that the result of the reaction was the formation of di-chlorobenzoic acid.

On Xylol.—N. Tawildarow.—The author describes—*β* nitro-xylol; boils at from 237° to 239°; fuses at 2°; sp. gr. at 17·5°, 1·126. *β* xylidine, and the oxalate of that base, of which latter salt 100 parts of water at 18° dissolve 3·319 parts. An acetyl derivative, $C_8H_9.NH(C_2H_3O)$, from *a* xylidine, fuses at 123°, boils at 310°, and is very difficultly soluble in water. When crude xylol is treated with nitric acid, a series of nitro acids are formed; ope among these yielded a barium salt, $(C_8H_7O_3)_2Ba+2H_2O$—that is to say, a new modification of toluylic acid, which the author calls pseudo-toluylic acid.

Combination of Ethylen with the Bromides of Iron and Platinum.—C. Chojnacki.—The author gives, at great length, an account of the experiments by which he succeeded in preparing compounds of ethylen with iron and bromine, and also of the ethylen with platinum and bromine. The former combination, $C_2H_4.FeBr_2+2H_2O$, contains, in 100 parts, 20 parts of iron, 57 of bromine, and 13 of water. The formula of the platinum combination is $C_2H_4.PtBr_2KBr+H_2O$.

Researches on Sorbinic Acid, and on so-called Para-Sorbinic Acid.—J. Barringer and R. Fittig.—This lengthy memoir is divided into the following sections:—Action of hydrogen upon sorbinic acid, yielding hydro-sorbinic acid, $C_6H_{10}O_2$, a colourless, peculiar smelling liquid; sp. gr. at 19°, 0·969; boils at 204·5°; is not solidified at −18°. Several of the salts of this acid are described. Action of bromine upon sorbinic acid.

Conversion of Piperonylic Acid into Protocatechutic Acid.—J. Remsen and R. Fittig.—This paper is chiefly a series of lengthy and complicated formulæ.

Contribution to Our Knowledge on Oil of Rue.—A. Giesecke.—The author of this memoir first refers at some length to the labours of a large number of chemists on this subject. He next relates a series of his own experiments chiefly made with the view to settle the question regarding the true chemical nature of oil of rue, which some consider to be a methyl-caprinol, $C_9H_{19}-CO-CH_3$. This view is confirmed by the author, who, moreover, has gone more deeply into this subject, treating on the action of nascent hydrogen on oil of rue, and the action of pentachloride of phosphorus on this substance.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 2, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Contribution to Our Knowledge on the Dyas and Coal Formation in the Banate.—D. Stur.—The meaning of dyas is sometimes, and more usually, expressed by Permian; this latter term is derived from Perm, a large district of Russia, which is characterised by a peculiar formation of rocks. The contents of this paper chiefly relate to phuto-paleology—that is to say, a description of extinct plants found in the formations alluded to, situated in the Banate, a large district of Hungary.

Geological Studies Concerning the Orient.—F. Chevalier von Andrian.—This paper contains the detailed mineralogical description of various minerals composing the volcanic rocks bordering on the Bosphorus. The following chemical analyses made by M. Karl Ritter von Hauer, are quoted in this memoir:—Andesite, in 100 parts—Silica, 63·87; alumina, 15·76; protoxide of iron, 5·43; lime, 3·66; magnesia, 1·06; potassa, 3·33; soda, 3·59; loss by ignition, 2·05;—total, 98·75. Greenstone, in 100 parts—Silica, 55·53; alumina, 13·81; protoxide of iron, 6·74; peroxide of iron, 4·45; protoxide of manganese, a trace; lime, 4·13; magnesia, 2·41; potassa, 3·64; soda, 3·26; loss by heat, sulphuric and carbonic acids, and water, together, 6·38;—total, 100·35.

Trinkerite, a Newly-Discovered Fossil Resin.—Dr. G. Tschermak.—The author states that the resin alluded to is found in compact masses in the braumkohle formation, near Carpano and Albona, in Istria. The resin is brittle; its colour varies from hyaciath red to chestnut brown. The mineral exhibits a fatty gloss; is transparent; its fracture plano-conchoidal; sp. gr., 1·025; becomes highly electric when rubbed; gives off, on being gently heated, and also while being pulverised, an aromatic pleasant odour; its melting-point varies from 168° to 180°. When fused, the substance gives off a nasty pungent smell; and, when the molten mass begins to boil, vapours are given off, which, when carried into solutions of lead or copper salts, cause a black precipitate therein. This resin was chemically investigated by Professor Hlasiwetz, the result of whose research is as follows:—The substance is hardly soluble in alcohol or ether, but is perfectly soluble in boiling benzol; heated in a retort, it melts, begins to boil, then gives off sulphuretted hydrogen gas, and yields an oily distillate. The

elementary analysis led to the following percentage result:—Carbon, 81·1; hydrogen, 11·2; sulphur, 4·7; oxygen, 3·0; no ash. When treated with fusing caustic potassa, the resin is oxidised; but the products of this reaction did not yield anything specific. The resin appears to belong to the substances akin to copal; but the fact that it contains sulphur is peculiar, since as yet no other fossil-resin containing sulphur is known, except the tasmanite described by Dr. Church (*Phil. Mag.*, vol. xxviii., 1864, p. 465). The name of trinkerite has been given to the substance alluded to in order to commemorate the discoverer, M. J. Trinker, geologist at Laibach. Although the composition of tasmanite (viz.—carbon, 79·34; hydrogen, 10·41; sulphur, 5·32; oxygen, 4·93) is very nearly the same as the mineral just mentioned, the tasmanite is intimately mixed with from 60 to 70 per cent of clay (deducted, of course, in the analysis just quoted); and tasmanite, moreover, is altogether insoluble in benzol, Dr. Hlasiwetz having purposely tested this reaction with a specimen of tasmanite kept in the Imperial Mineralogical Museum at Vienna.

Bayerisches Industrie und Gewerbe Blatt, July, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Production of Cold by Mechanical Means.—C. Linde.—This lengthy memoir, illustrated by geometrical figures and a series of algebraical formulæ, treats chiefly on the question of the amount of force to be applied in order to obtain the withdrawal of a certain amount of heat at a given temperature.

Description of an Apparatus for the Manufacture of Gas from Petroleum and from Residues left by the Distillation of that Liquid.—L. A. Riedinger.—This paper, illustrated by a series of exceedingly beautiful lithographs, contains the description of a well-arranged apparatus to produce gas from crude petroleum, or from the residues of its distillation. That industry has become rapidly developed on the Continent, as well as in the United States of America; and it is a wonder that it is not thought of in this country, the gas thus produced being far superior to coal-gas. The apparatus here alluded to is only contrived for use on a comparatively small scale (for 300 lights), but in many parts of Switzerland and Germany towns and villages are cheaply and effectually supplied with petroleum gas.

Revue des Cours Scientifiques de la France et de l'Etranger, September 10, 1870.

This number does not contain any paper or memoir relating to chemistry or physical sciences, but it opens with a brief and modest eulogium on M. Jules Simon, the new Minister of Public Instruction, reminding, at the same time, that this gentleman was, on December 2nd, 1851, the most influential of the Professors of the Sorbonne, and a man who, in every respect, is eminently fit to be the head of the important public department just named.

Journal für Gasbeleuchtung, August, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Report of the Proceedings of the Tenth Annual Meeting of the Gas Engineers and Gas Works' Managers in Germany, held at Hamburg in the month of May last.—Dr. N. Schilling.—This report contains the following sections:—A paper on the establishment of an experimental gas work, to be constructed with the view of testing coals and making experiments on various matters of practical interest, the works to be the property of the Association. The experiments intended to be made are:—The accurate determination of the quantity of gas made from a given weight of coals after complete purification of the gas from sulphuretted hydrogen, ammonia, and carbonic acid. Determination of the specific gravity of the gas by the method of the velocity of efflux, as compared with atmospheric air; quantitative estimation of the heavy hydrocarbons contained in the gas, by means of absorption in the eudiometer; estimation of the illuminating power, according to a plan fully detailed by a sub-committee of the Association; estimation of the quantity of coke, by weight as well as by measure, care being taken to extinguish this material, when taken from the red-hot retorts, in a peculiar manner, without contact of air; estimation of the value of the coke as fuel; estimation of the value of the tar, and of the ammoniacal liquor, for various purposes.

Detection of Sulphur in Coal-Gas.—M. Ulex.—The author says—The presence of sulphur in coal-gas can be proved in the following simple manner:—Let a platinum basin be filled with half a litre of water, and the basin be heated over a Bunsen burner until all the liquid has evaporated; the basin will be found to be coated, on the outside, where it has been struck by the flame, with a dirty, greasy looking substance, which, on being washed off with pure distilled water, and tested, proves to be sulphuric acid. The author further points out that the glass chimneys used with Argand gas-burners soon become coated over internally with a white substance, which, on being washed off with distilled water, will be found to be, on testing, sulphate of ammonia. The glass panes of a room wherein gas is burned for a few evenings consecutively will, when rubbed with the fingers of a clean hand, impart to it a substance which, on the hand being rinsed in distilled water, will yield a precipitate of sulphate of baryta with chloride of barium, and a brick-red precipitate with potassio-iodide of mercury.

September, 1870.

The original papers contained in this number do not, strictly speaking, relate to chemistry, but the titles of those which are of a more general practical interest are:—

Drainage considered in its bearing upon the Water Supply.—H. Speck.—This memoir contains some very interesting matters as regards the drainage of arable land and meadows, and the bearing thereof upon water supply.

Description of the Water-Works constructed in 1868 for the Supply of Good Potable Water to the City of Berne (Switzerland).—M. Rothenbach.—Illustrated with woodcuts.

Instructions, Rules, and Regulations concerning the Use of Gas and the Inspection of Gas-Works, Gas-Meters, and Gas-Pipes ordered to be observed by the Communal Authorities of Karlsruhe (Baden).—This paper is an excellent and brief epitome of, and guide for, gas managers, gas engineers, meter-makers, and gasfitters. It is a proof of the very great superiority of the technical instruction so generally spread over Germany; because, without sound knowledge no workmen could either understand or carry into effect what is here ordered to be done in the general interest of the whole community.

Pharmaceutische Zeitschrift für Russland, No. 1, 1870.

Since the beginning of this year this periodical has been published fortnightly, instead of monthly as before, but we have only just now received a portion of what has been published. The first number contains the following original papers and memoirs:—

Researches on the Fermentable Matter (Ferment Substanzen) contained in the Water of the River Newa, and in that of the Canals of St. Petersburg.—Drs. A. and F. Lösch.—This lengthy memoir contains the results of a series of experiments made with the view to ascertain, quantitatively, the presence of fermentable (that is, in this instance, "disease generating") matter which occurs in the waters above alluded to. The authors have, for this purpose, applied Schönbein's test, whereby the property of fermentable substances to decompose water is applied to the detection of the presence of these substances; while, moreover, the authors employed, for comparison's sake, a very weak solution of pure emulsine. The main result of these researches is chiefly of local importance to St. Petersburg only; but we learn that, while the water of the river Newa, even at the time of high floods, is comparatively very pure, and absolutely so in its normal state, the water of some of the canals contains a considerable quantity of fermentable matter.

No. 2.

On Ricinine and the Active Principle of Ricinus Seeds.—E. Werner.—After referring, at length, to Dr. Tuson's researches on this subject, the author describes a series of experiments, chiefly made with the view to obtain, from the ricinus seeds, an active principle suitable for medicinal use. As regards the ricinine of Dr. Tuson, prepared by the author in large quantity and according to Dr. Tuson's directions, it is stated that ricinine is not an alkaloid, and, moreover, a substance which contains a considerable quantity of ash; and the author, after carefully made analysis, comes to the conclusion that Dr. Tuson's ricinine is a compound of magnesia and of an organic acid, the formula of this body being $C_{11}H_{20}O_{10}Mg_3+6H_2O$.

Japanese Firework Mixture.—O. Görke.—The author recommends the following mixture:—Finely-pulverised nitrate of potassa, 70 parts; washed flowers of sulphur, 30 parts; *pulveris lycopodii*, 12 parts; best and very light lamp-black, 8 parts. From 1½ to 2 grains of this powder are sufficient for use packed in strips of suitable paper.

Occurrence of Naphtha and Ozokerite in Europe and Asia.—Dr. G. A. Björklund.—This lengthy memoir gives a detailed account of the enormous wealth of the Russian Empire as regards inexhaustible sources of naphtha and ozokerite, which latter is actually obtained by mining and quarrying in large quantities, and applied to the manufacture of paraffin, and, in some instances for the adulteration of bees'-wax.

No. 3.

Description of Various Pharmacognostic Substances met with in Central Asia.—Dr. R. Palm.—The author, a pharmaceutist residing at Taschkend (a large town situated at 43° 3′ N. lat., and at about 68° E. of Greenwich), describes at length, and in a tabular form, a series of substances, a large number of which are known in Europe, but many being altogether unknown there even by name. As instances, we mention—*Baladiir*.—A drug somewhat akin in shape, size, and colour to large plums, but containing an oily fluid, and also a seed somewhat akin to the kernel of the almond; this drug is used as a dye material. *Scharüm-Dorü*.—The dried leaves of an unknown plant containing a large proportion of bromides and iodides, and yielding, with water, a thick mucilage; this leaf is imported from China. *Iriana*.—Small bitter-tasted seeds, containing a peculiar essential oil. *Akir-kara*.—A dry root imported from China, and very highly prized and expensive; is used as anti-scorbutic. *Kapnarx*.—A dirty violet-grey coloured powder; taste, strongly astringent; is used as a dye-stuff for producing black with sulphate of iron. *Scharatsch*.—A powder similar in appearance to rye-meal; it is used, after having been mixed with water, as paste, but also as cattle fodder, and is apparently the powder of an orchideous root. We cannot continue this lengthy catalogue; but it appears, from its contents, that the inhabitants of the Khokand are a far more civilised, and, also, industrially-developed, people than would appear to Europeans to be the case. Indeed, the

author of this paper states that these Tartars are acquainted, not only with drugs, dye-stuffs, and other substances entirely unknown in Europe, but also with industrial processes with which Europeans are not acquainted.

NOTES AND QUERIES.

Black Japan.—I shall be glad if you can tell me how to make the black japan that is used for coach work.—S. R. H.

Anthracene.—Will any reader of your valuable journal, inform me if there is any market for artificial anthracene, and what the price is?—H. J.

Hofmann's Violet.—(Reply to "Querist.")—You will find the reply to some, if not to all, of your queries in the work "On Aniline and its Derivatives," published by Longmans and Co., 1868.

Estimating Cyanides.—I should be glad of the best method of estimating the cyanides in brown sulphate of ammonia: the methods in the ordinary text-books not being found satisfactory.—E. Outhet.

Manufacture of Sulphuric Acid.—(Reply to "A Manufacturer.") In all probability the process you refer to is that of P. W. Hofmann, described in Chemical News, vol. xxi., p. 106, and also referred to in the same volume, p. 164.

Carbonic Ether.—(Reply to H. S.)—You will not be likely to buy this compound. According to the account given thereupon in the latest edition of the late Dr. W. A. Miller's work, "Elements of Chemistry," vol. iii., p. 225, it can be formed by heating argentic carbonate with iodide of ethyl, in a closed tube; but it is generally procured by heating sodium or potassium with oxalic ether.

Bleaching Wax.—(Reply to F. C. Terrell).—The bleaching of bees'-wax and paraffin-wax (which is simply paraffin) cannot be effected by one and the same process. As regards the bleaching of bees'-wax, the description of that process is far too lengthy to be here detailed even in brief outline, and you had best consult on that subject Ure's "Dictionary of Arts, &c.," 6th edition, vol. iii., p. 1040. The same observation applies to paraffin, on which you will find an excellent article in the work just quoted, same vol., pp. 360 to 371.

Drying Oil.—(Reply to R.)—You wish for a good drying linseed oil, prepared without heat, by which is really understood that it be rendered drying without the usual process of boiling. Mix with old linseed oil, the older you can get it the better, 2 per cent of its weight of manganese borate (this salt is readily prepared by precipitating a solution of sulphate of manganese with a solution of borax, wash the precipitate, and dry it either at the ordinary temperature of the air or at 100°), and heat this mixture on a water-bath, or, if you have to work with large quantities, with a steam-bath to 100°, or at most 110°; you thus obtain a very excellent, light-coloured, rapidly-drying oil; by keeping the mixture stirred, that is to say, by always exposing fresh portions to air, the drying property of the oil is greatly promoted. The rapidity of the drying of the oil after it has been mixed with paint, on surfaces besmeared therewith, does not simply depend upon the drying property of the oil, but, in a very great measure, upon the state of the atmosphere—viz., whether dry or moist, hot or cold—the direct action of sunlight, and the state of the surfaces on which the paint is brought. Really genuine boiled linseed oil, if well prepared, leaves nothing to be desired as regards rapidity of drying, but it is retarded by various substances which are added in practice, among which, especially, oil of turpentine is injurious.

Hard and Soft Water.—(Reply to "Sanitas.")—Soft water does not necessarily imply rain-water; for instance, the waters supplied to Glasgow and Edinburgh are soft, and not, therefore, rain-water, in the sense you take it. The water supplied to the Metropolis becomes considerably softened by ebullition, on account of the precipitation of the carbonate of lime held in solution by carbonic acid, which escapes during the boiling. As regards drinking, we are inclined to think that, generally speaking, cold water is not too much used in the Metropolis, and what is used for that purpose is sufficiently soft and pure; indeed, the water supplied to some other towns of this country —*e.g.*, Sunderland and South Shields—although very much harder than London water, is pleasanter and more refreshing to drink, on account of the far larger quantity of free carbonic acid contained in the water pumped up from deep wells bored into the rock. In many parts of Germany, especially in the province of Nassau, all spring water in ordinary use has a somewhat mineral taste, but its use does not injuriously affect the health of the inhabitants. The very pure water of the Rhine is not, in Germany at least, used for drinking or culinary purposes, unless by the shippers and crews of steamers and other vessels navigating that river.

TO CORRESPONDENTS.

J. Farie.—(1.) We know of no recent Chemical Catechism. (2.) Roscoe's "Elementary Chemistry."

R.—Hardwich's "Photographic Chemistry," or Lake Price's work.

T. J. F.—Both your communications have been received.

R. Heaton.—Received; thanks.

A. E. J.—The subject is a metaphysical one, which it would be a waste of time to discuss.

R. E. Bibby.—You will probably get aureoline at Winsor and Newton's, Rathbone Place, W.

R. H. and Sons.—The work will not be ready yet.

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THE CHEMICAL NEWS.

VOL. XXII. No. 570.

SOLAR SPECTROMETRY.

REFERRING to Professor Young's spectroscopic notes published in our last issue, Mr. J. Norman Lockyer, F.R.S., writes to remind us that he saw sodium and magnesium prominences bright over sun spots a long time ago. The following appears in No. 5 of his "Spectroscopic Observations of the Sun," published in *Proceedings of the Royal Society*, No. 115, 1869, page 74:—

"Bright prominences, when seen above spots on the disk, if built up of other substances besides hydrogen, are indicated by the bright lines of these substances in addition to the lines of hydrogen. The bright lines are then seen very thin, situated centrally (or nearly so) on the broad absorption-bands caused by the underlying less-luminous vapours of the same substances."

NOTES ON A PROCESS FOR THE PRESERVATION OF BUILDING-STONES.*

By A. H. CHURCH, M.A.

MY attention was directed to the subject of the preservation of stone about 1860. In 1862 I took out a patent for this purpose. The process consisted in the alternate application of solutions of pure baryta and pure (dialysed) silica. The plan was partially successful, and possessed the great advantage of causing no discolouration or efflorescence on the stone. But the solutions were rather weak, and, therefore, many repetitions of the process were necessary to secure an effective protection. Then, too, the silica solution failed to penetrate calcareous stone to any appreciable depth, owing to its rapid coagulation. After some years of further experiment, improvements were devised which ultimately resulted in a new and much more successful process. This process, for which a patent was obtained, in 1869, by Ransome's Patent Stone Company, consists in the successive and repeated application of three liquids. The first of these is a solution of monocalcic phosphate, often erroneously termed biphosphate of lime, and first introduced, I believe, for a similar purpose, by Coignet. The second solution is one of barium-hydrate, applied warm if possible; and the third is a dialysed solution of silica, to which small quantities of the ordinary potassium and sodium silicates of commerce have been subsequently added.

It will not be necessary to dwell upon the proper methods of applying these solutions, nor upon the details of their manufacture. I may, however, mention that there is no difficulty in obtaining the various solutions in a state of sufficient purity and strength, and at a sufficiently low rate, to admit of their economical employment for the purpose in view. And it may be interesting to state that the dialysers employed, which are of the capacity of 6 gallons or more, and of an open bell shape, are found capable of doing their work very successfully when floated on or suspended in barrels of rain-water, or on rafts in a tank or pond; the movement of water below the diaphragm of vegetable parchment increases remarkably the rate of separation.

The reactions which take place between the several solutions themselves and between the solution and the constituents of the objects treated cannot be described in detail. The mono-calcic phosphate becomes chiefly di-calcic phosphate in contact with a limestone, and then, on the application of baryta, a barium di-calcic phosphate is formed. If decay has already taken place, and sulphates have been formed in the stone, these are converted into insoluble and non-efflorescent barium sulphate, while the lime and magnesia thus liberated immediately become phosphated by the subsequent application of the mono-calcic phosphate solution. The siliceous solution finally employed keeps good some time, and penetrates some distance beneath the surface. It contains, indeed, a small quantity of alkalies, but their amount is not sufficient to produce any soluble salts in the treated stone or bricks. It would be tedious to enter into the proofs of this statement furnished by direct experiment. Extensive trials of the new process have been made on many important buildings, some of which have been entirely treated by the three solutions described above. I may cite as examples of the use of the process, the Chapter House at Westminster, and the St. Pancras Midland Terminus; portions of Canterbury Cathedral have also been submitted to treatment, together with numerous other buildings, public and private. Where the direction has been carried out with fidelity the results have invariably promised well. No marked alteration of the appearance of the stone is to be seen after the lapse of a few months from the time of using the process. The waterproofing of the stone effected by the use of the solutions is seen in many ways, particularly when after a shower of rain the colour of the treated surfaces is seen not to be darkened by absorption of water. A piece of black cloth drawn over a piece of Bath or Caen stone after treatment neither blackens the stone nor is itself whitened by it.

I may add, in concluding this very imperfect notice, that my process is one of those just selected (1870) for the renewed trial at the Houses of Parliament. The specimens exhibited are treated and un-treated specimens of the chief stones employed at the Chapter House, Westminster, and at the St. Pancras Terminus.

* Read before the British Association, Liverpool Meeting, Section B.

ON THE MAXIMUM OF MAGNETIC POWER EVOLVED BY A GALVANIC BATTERY.*

By the Rev. H. HIGHTON, M.A.

IN trying experiments on this subject, the author found that the magnetic power evolved by a given battery could be increased without limit. This was the case both in theory and practice.

Thus, if F = magnetic force of current in a unit of length of wire, E = electro-motive power, R(b) = resistance of battery, $r(w)$ = specific resistance of wire, l = length of wire, s = section of wire—

$$F = \frac{E}{R(b) + r(w)\frac{l}{s}}$$

And if M = total magnetic force in the whole length of wire—

$$M = F \times l = \frac{El}{R(b) + r(w)\frac{l}{s}}$$

But if the length and section of the wire be increased in proportion, l becoming nl and s becoming ns, the equation becomes—

$$M = \frac{Enl}{R(b) + r(w)\frac{nl}{ns}} = \frac{Enl}{R(b) + r(w)\frac{l}{s}}$$

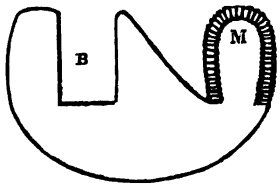
In other words, by simply increasing the length and section

* Abstract of a paper read before the British Association, Liverpool Meeting, Section A.

of the wire, the magnetic power may be increased without limit.

The experiment may be tried as follows :—

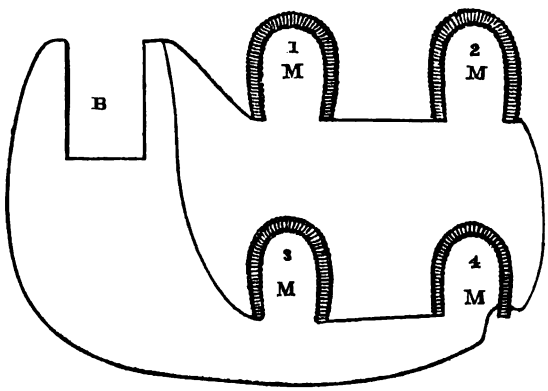
FIG. 1.



Let B be a galvanic battery, and *m* an electro-magnet supporting a weight of *n* lbs.

Change the arrangement as follows :—

FIG. 2.



Let B be the same battery, and $\overset{1}{m}$, $\overset{2}{m}$, $\overset{3}{m}$, $\overset{4}{m}$, be four electro-magnets exactly similar to the former one. Let half the current go through the magnets $\overset{1}{m}$ and $\overset{2}{m}$, and the other half through $\overset{3}{m}$ and $\overset{4}{m}$; then it will be found that each magnet sustains $\frac{n}{2}$ lbs., or the whole four will bear 2 *n* lbs., or twice the weight sustained before.

And the same process may be repeated or varied *ad infinitum*. Can we then get infinite power out of a finite source of force? Yes; but, on this condition, that what we gain in power we lose in time; for the current would take twice as long to traverse the second circuit, and, therefore, it takes double the time to produce double the magnetic power. But the electric current is so rapid that this difference of time is inappreciable within any practical limits.

It may be said that in this arrangement we are doing no work. This is so far true, that we are only doing work while the soft iron is being magnetised, and pressing the iron keeper to itself. But this work is being done every time that the circuit, after being broken, is closed; and the circuit may be broken and closed so many times a second that the number is practically illimitable, and hence the amount of work which can be done by a given battery is illimitable. The only question is a question of first cost of machinery.

What becomes of the electric power in the interval between the moment when the soft wire becomes fully magnetised, and the moment when the circuit is broken? It is wasted in producing heat in the wire,* and the smaller this waste the greater the available magnetic power.

All the relations given in our text-books between amounts of electrolysis, electric force, heat, and motion, are true only partially and in particular cases. The author hopes, at some future time, to show how far they are true, and where they fail.

According to Joule, Favre, Silbermann, and others, the consumption of a gramme of zinc in a battery produces about 550 units of heat (each unit being able to raise about 423 grammes through 1 metre), or = about 232,650 grammes raised 1 metre. But Faraday said a grain of zinc produces more force than any flash of lightning; and Weber and Kohlrausch say that the force which decomposes 9 milligrammes of water—that is, *the force of oxidation of 1 milligramme of hydrogen, can raise* 208 *tons* 1000 *metres!* and a gramme of zinc will produce thirty times as much heat as a milligramme of hydrogen.

At a future time, the author will show the fallacies involved in all these calculations. Meanwhile, enough has been said to set aside the *à priori* argument against electro-dynamic engines—namely, that as a pound of zinc can only produce a certain amount of heat, and a pound of carbon, which is much cheaper, can produce more heat, therefore electro-dynamic engines can never compete with steam engines. In fact, it is a question of prime cost of machinery, and skill in construction, and not of cost of working.

* Since writing the above, I have found strong reasons for doubting the truth of this statement; but I propose shortly publishing a full discussion of this point.—H. H.

ON THE CHEMICAL COMPOSITION OF THE BONES OF GENERAL PARALYTICS.*

By J. CAMPBELL BROWN, D.Sc.,
Lecturer on Chemistry and Toxicology at the Liverpool Royal Infirmary School of Medicine.

IN consequence of the large share of public attention which has lately been attracted to the occurrence of fractures of the ribs among the patients in our lunatic asylums, several specimens of ribs of general paralytics have been sent to my laboratory.

The general appearance of all of them is so unlike that of the ribs of healthy adults, that I have been induced to submit average samples of them to analysis. In the accompanying table, the first four columns of figures show the composition of these samples.

I. Consisted of six ribs, which had all been fractured in a straight line downwards, and had completely united again by firm bony union; they showed slight callosities; some of them had again been fractured more recently, and had only imperfectly united; they contained an unusual amount of fat. Portions of the ribs were removed and were freed from fat before they were submitted to analysis, and the remaining portions were handed to the curator of the Museum of the Liverpool School of Medicine. The age of the subject from which they were taken was thirty-nine.

II. These ribs were not fractured, nor did they contain much fat; they were, however, thinner than usual. They were taken from the body of a patient who had suffered from mania with general paralysis.

III. Consisted of one rib only; it was slender and rough, and jagged on the edges, but had not been fractured. It was taken from the body of a woman aged forty.

IV. Shows the average proportions of organic and earthy matter in several samples not more completely analysed, which were remarkable only for being less perfectly developed than the ribs of healthy adults; some of these had been fractured and perfectly united, others were entire.

For comparison with these, I give the composition of the femur and tibia of a nine-months' fœtus in column V., and of the bones from a case of osteo malacia in column VI.

VII. Is calculated from the analysis of a healthy adult tibia, by Valentin.

* Read before the British Association, Liverpool Meeting, Section B.

VIII. Is calculated from the analysis of a healthy man, aged twenty-five, by Von Bibra.

Table of Analysis of Bones.

Constituents.	Ribs of General Paralytics.				V.	VI.	VII.	VIII.
	I.	II.	III.	IV.	Nine months, Fœtus.	Osteo mal-acia.	Adult Tibia (Valentin).	Adult Ribs (Von Bibra).
Phosphoric acid	23·52	22·85	19·09		23·31	16·89	24·24	25·95
Lime	29·57	28·54	25·25		28·98	22·20	32·98	34·43
Magnesia and alkalies.	0·41	0·43	0·37		0·36	1·05	1·37	1·67
Carbonic acid	1·55	1·29	2·09		1·10	1·71	3·37	2·90
Total inorganic constituents.	55·05	53·11	47·80	49·46	53·75	41·85	61·96	64·95
Organic constituents	44·84	47·02	53·05	50·54	47·15	58·16	38·02	33·97
	99·89	100·13	101·30	100·00	100·90	100·01	99·98	*98·92
Ratio of lime to 71 phosphoric acid	89	88	93		88	92	97	94

It will be observed that the ratio of organic constituents to earthy matter is much greater, and also that the ratio of lime to phosphoric acid is distinctly less in the ribs of paralytics than in those of healthy adults.

There are the same differences between the composition of healthy ribs and those of paralytics as between the composition of the adult large bones and those of the fœtus. And, generally, the composition in cases of paralysis approaches that observed in cases of osteo malacia.

Whether the defects in the ribs of paralytics are due to arrested development, or to degeneration of the fully developed bone, it will require further experiments upon carefully selected cases to prove; but from the evidence already obtained, I am led to conjecture that both causes will be found to operate, but principally the former.

I exceedingly regret that more analyses have not been made before this time; it will be readily understood that specimens of bones cannot be made to order; we must wait until they can be obtained at *post mortems*; and I propose to continue the enquiry when more specimens have been obtained.

The result of the analysis quoted is suggestive, rather than conclusive, as to the condition of the bones in patients the subject of general paralysis, and it is clearly unsafe to generalise from a few examples. These analyses, however, form a first instalment towards determining whether the statements that have been made as to the peculiar liability to fracture of the bones in certain forms of insanity holds good as a general rule.

ON THE CALORIFIC POWER OF HARE'S BLOWPIPE.

By HENRY WURTZ.

OBSERVING in a lately received issue of the CHEMICAL NEWS, my first *partial* reply to Dr. W. M. Watts, I am encouraged to enclose a supplementary note in completion of said reply, lately printed by me in my own journal (*The American Gaslight Journal*). I perceive that Mr. Watts has also added a rejoinder to the aforesaid partial reply, which calls for a further continuation of the discussion on my part. I am gratified by the courteous tone of Dr. Watts's rejoinder, which I shall emulate.

Dr. W. M. Watts, in his strictures on the discussion of Professor Silliman and myself of the "Calorific Powers or Effects of Gases," objects to our formula for the total heat of the oxyhydrogen flame, namely—

$$\frac{34462-(9\times 537^\circ)}{4{\cdot}3245}=6851^\circ;$$

remarking that "there is an error in assigning to liquid water the specific heat 0·4805, instead of 1. The formula should be—

$$\frac{34462-9\,(637-48{\cdot}05)}{4{\cdot}3245}=6743^\circ."$$

Dr. Watts's other points were probably sufficiently met in my reply, but this point was at that time expressly reserved, as looking to considerations which had already led to some little oral discussion between us, and with others.

Having had no opportunity, as yet, for that mature deliberation, in conjunction with Prof. S., that I desired to have, before going into print further on these questions of specific heat, and feeling that delay may cause misconstruction, I have given to them individually such consideration as I have had time for, and have decided to present a reply to Mr. Watts, in anticipation of our joint reply. In the preparation of the latter, arranged for an early day, any new lights that may appear in the interim, will of course be available.

Previous to the date of the first publication of our joint paper in the course of conversation with Prof. H. F. Walling, he made to me the suggestion that it was possible our formula ought to be so modified as to read—

$$\frac{34462-9\,(537+51{\cdot}95)}{4{\cdot}3245}=6743^\circ$$

leading, as will be seen, to the same figure as that of Dr. Watts. Prof. Walling, however, expressed himself as by no means *sure* of his view, as he had given no especial study to the subject, and offered it merely as an hypothesis. The apparent coincidence here gives more interest to the subject.

It is to be observed that Dr. Watts's formula supposes the temperature of the pound of hydrogen started with, in the combustion, to have been zero, and, further, that each of the nine pounds of water (as water) must have absorbed and retained 100° of sensible heat. Hence his figure 637°; which he diminishes, however, by 48·05°, for reasons which, as follows from the context, arise out of the difference between the specific heats of water and steam. The only conclusion I can draw from this is that Dr. Watts believes it requires an absorption of 51·95° of sensible heat from 1 pound of water at 100°, to convert it into 1 pound of steam at 100°, *plus* the 537° of latent heat generally admitted as the *actual result of experiment*; or, as may otherwise be stated, follows from Dr. Watts that the latent heat of steam at 100°, instead of 537°, is really 537° +51·95=588·95°. I prefer as yet to stand by the experiment, until I receive from Dr. Watts some clearer explanation.

In the case of Prof. Walling, whose doubtfully submitted hypothesis also arose out of the consideration of the difference between the specific heats of water and steam, in the first place, it is clear at a glance, that the coincidence in the resulting figure is not accidental;

for 637—48·05=537+51·95;

and from this formula it is still more evident that, in addition to the 537° known by experiment to be all the heat that actually becomes latent in the conversion of one pound of water at 100° into one pound of steam at 100°, 51·95° more must be supposed to become latent, leaving but 48·05° of the sensible heat of the boiling water to remain sensible in the steam, and again increasing the latent heat of steam to the hypothetical number, 588·95°.

There must be a reason for every error (if this be one, as I cannot but conclude), as well as for every truth; and in seeking for the cause of this one, it seems to me to arise from a notion of specific heat, as absolute quantities, instead of mere *ratios*. The name is good, as it means

* This specimen also contained fat which had not been removed before analysis.

merely that different *species* of matter are differently affected by equal additions of heat; and specific heats are merely the ratios of these differences. When a body changes its state, as from water to steam, the 537° required to produce this change of state produces also a *change of specific heat.* The sensible heat remains unaltered. The 537° must come from external sources. Steam is different in species from water, and possesses a different specific heat ratio. Time fails for a fuller exposition of this subject now.

With regard to our formula for the total heat of Hare's blowpipe, though Dr. Watts's correction, as I have endeavoured to show, does not appear to me sustainable, there has occurred to me a small correction, necessary to precision, which I shall call attention to, here and hereafter, for the reason that the principle on which it depends, is, in its application to combustible gases, becoming now of practical importance. This is merely a correction for the temperature of the hydrogen before burning, which, for simplicity, Silliman and Wurtz assumed to be zero. If this temperature is the ordinary one of 60° F. (=15·6° C.), at first glance it might appear necessary merely to add 15·6° to the 34462 in the numerator of our fraction. This would involve an error, however, which, though trifling here, would be very important in cases where the combustible or supporter of combustion is highly heated beforehand. Such cases I will discuss at an early day hereafter. Here I shall merely explain that in the oxyhydrogen flame, we must first calculate the mean of the specific heats of the gases in combustion, thus—

$$\frac{3{\cdot}409+(8\times 0{\cdot}2175)}{9}=0{\cdot}5721;$$

and we shall then have, instead of 7969°, the figure calculated, in our joint paper, by Silliman and Wurtz, a temperature differing so little therefrom as to be scarce appreciable—

$$\frac{34462+15{\cdot}6\left(\frac{1}{0{\cdot}5721}\right)}{4325}=7975°.$$

The explanation of the details of this calculation I must for the present defer.

LIME-LIGHTS IN THE CAISSON OF THE EAST RIVER BRIDGE.*

ON page 190 of the last volume of the CHEMICAL NEWS, the fact was alluded to that arrangements had been made with the New York Oxygen Gas Co., to supply gas for a series of lime-lights by which the six compartments of this huge caisson might be lit.

We can now from personal inspection describe the arrangements by which some fourteen of these lights are kept in constant and successful operation. The plan of these adjustments is we understand, chiefly due to Mr. Martin, Assistant Engineer. To secure a steady supply of each gas under constant pressure, two large sheet-iron cylinders, about 21 inches in diameter and 6 feet high, are placed upon the top of the caisson, and are connected by iron piping with a water reservoir on the roof of an adjacent building, by which means a hydrostatic column or pressure of some 16 pounds per square inch is made available. These cylinders being filled with water, the gas is let into them from the portable cylinders supplied by the Oxygen Co., in which it is compressed up to a pressure of 225 pounds to the square inch. This displaces the water, forcing it back into the elevated tank and leaving only the tension due to its hydrostatic column of 32 feet.

Glass gauges exactly like those used on steam boilers show the level of the water in the stationary cylinders, and thus enable the attendant to regulate the supply of gas in these, so as neither to overcharge them (when the excess would escape through the water-pipes and tank) nor allow them to become empty.

From the upper part of the gas reservoirs or stationary cylinders just described, service pipes are carried down into the caisson, and there distribute to the outer ends and middle points of each chamber where the usual jets and lime holders are permanently attached.

The light afforded by this means is excellent, and if it is possible (as we imagine it must be) to whiten the roof and upper part of the caisson walls, its efficiency would be very largely increased. In looking from one chamber of the caisson into another, where one of the lights was near the doorway but out of view, we were strongly impressed with the idea that daylight was entering through some unexpected opening. The foggy state of the air causes a considerable loss of light, so that at a distance from the burner this is less effective than one might expect. With the number of lights now in use, however, the supply is sufficient, and candles are only required in a few locations sheltered from the direct rays. We feel sure that a whitening of the roof and walls would be of very great service.

It is proposed to let the gas reservoirs descend as the caisson goes down, building around them a coffer-dam, by which means the hydrostatic head will be increased exactly as the air pressure in the chambers is raised, so that a constant difference will be maintained.

The greatest depth to be reached being 40 feet, the maximum pressure required, according to the present standard, would be about 36 pounds, and the pressure in the small charged cylinders being 225 pounds, no difficulty will be found in introducing the gas from them. The pressure now used is, however, largely in excess of what is required, as one or two pounds above that in the caisson would be quite sufficient to secure the steady burning of the lights. In fact, we are sure, from previous experience, that the pressure between the stop-cocks of the jets and the flames is now not more than a small fraction of a pound per square inch in excess of the surrounding compressed air. Were there any object in reducing it, we are quite confident that 25 pounds above the atmosphere would be an abundant pressure at the maximum depth of 40 feet.

The amount of gas now consumed is about 1200 cubic feet of each kind per day.

* Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute.*

THE RISE AND FALL OF THE DEFUNCT ELEMENTS.*

By Dr. H. CARRINGTON BOLTON.

A COMPLETE catalogue of so-called "Defunct Elements," is nowhere found, but notices of their *rise* and *fall* are scattered throughout periodical literature; from these the following list has been compiled, which, if incomplete, is still comparatively full. Within the limits of this abstract, little more than the date, name of discoverer, and references can be given. Taking them up in chronological order, the first is

Terra Nobilis, discovered in 1777, by Tobern Bergmann, who extracted it from diamonds.

Hydrosiderum, discovered by Meyer, in 1780, and obtained by dissolving crude iron in acids, the residue being the new element. It is called in German *Wassereisen.* Klaproth showed that it consisted of iron combined with phosphorus. (*Schrift. Ges. Nat. Freund, Berlin*, ii., 334; and iii., 380.)

Saturnum, discovered in 1784, by Monnet. (*Journal de Physique*, xxviii.)

Diamanthspatherde, discovered in 1788, by Klaproth, in corundum. (*Beschäft. Ges. Nat. Freunde, Berlin*, viii., St. 4.)

* From the *Proceedings of the Lyceum of Natural History, New York.*

Australia, discovered in 1790, by Wedgewood, in sand from Australia, and examined by Hatchett, who pronounced it a mixture of alumina, iron oxide, silica, and graphite.

Nameless earth. Fernandez, 1799. *Scherer's Allg. J.*

Agusterde was extracted from the mineral known as *sächsische-beryll*, by Trommsdorff, in the year 1800. Vauquelin showed it to consist of phosphate of lime, the mineral being known as apatite. (*Scherer's Allg. J.*, iv., 312; also *Gehlen's Allg. J.*, i., 445.)

Silene, Proust, 1803. (*Journal de Physique.*)

Pneum alkali, discovered by Hahnemann in 1801. It was sold at the price of one gold Frederic the ounce, but eventually proved to be borax.

Niccolanum, was found in cobalt ores by Richter, in 1805, but was shown to consist of a mixture of nickel, cobalt, arsenic, and iron. (*Gilb. Ann.*, xix. 377.)

Andronia, an earth which existed only in the imagination of J. J. Winterl, of Pesth. He prepared it by igniting charcoal with saltpetre and exhausting with water, the residue consisting of *andronia*. His statement excited much controversy; a committee of the French Academy of Sciences appointed to examine it, proved that it was but a mixture of lime, alumina, iron oxide, and silica, which materials, it was suggested, came from the earthen crucibles in which Winterl conducted the experiments. (*Gehlens J. und Gilberts Annalen.*)

Thelike, discovered by Winterl.

Nitricum, is the imaginary body, which, according to Berzelius, united to oxygen formed nitrogen.

Araeon, is in accordance with Meissner's views, *ponderable caloric*; thus hydrochloric acid is composed of two equivalents of oxygen and one of water, combined with araeon and the imaginary radical murium. (*Handwörterbuch.*)

Junonium, discovered by Thomson, in 1811, but its identity with cerium was soon proved by Wollaston. (*Phil. Mag.*, xxxvi., 278; also *Gilb. Ann.*, xliv., 113.)

Thorium; the first element known by this name, proved to be phosphate of yttria. (*Schweigg.*, xxi., 15; *Pogg. Ann.*, iv., 145.)

Vestium, discovered in 1818, by von Vest. Faraday showed that it consisted of a mixture of iron, nickel, sulphur, and arsenic. (*Gilb. Ann.*, lix. and lxii.)

Wodanium, extracted from the so-called *Wodankies* by Lampadius, 1818, but shown by Stromeyer to consist of nickel, arsenic, &c. The mineral is now known as Gersdorffiite. (*Gilb. Ann.*, lx. and lxiv.)

Crodonium, discovered by Trommsdorff in 1820, was found in an incrustation, on a carboy of sulphuric acid imported from England. Its name is derived from *Crodo*, an idol held in veneration by the ancient people of Thuringia. Trommsdorff afterwards showed that it was but lime and magnesia, rendered impure by copper and iron. (*Gilb. Ann.*, lxv. and lxvi.)

Apyre, Brugnatelli, 1821. (*Gilb. Ann.*, lxvii.)

Pluranium, *Polinium*, and *Ruthenium*, all three discovered by Osann (1828), in platinum ores from the Ural Mountains. (*Pogg. Ann.*, xiii. and xiv.)

Donium, discovered in 1836, by Richardson, in a mineral from Aberdeen, but its identity with glucinum was afterwards established by Heddle. (*Ann. Chem. Pharm.*, xlx. and xxiii.)

Treenium, discovered by Boase, in 1836, and partly supposed identical with donium. (*Thomson's Records Gen. Sci.*, iv., 20.)

Terbium, found accompanying erbium in gadolinite, by Mosander (1843); but pronounced by Berlin (1860), to have no existence. (*Ann. Chem. Pharm.*, lxviii., cxxxi., cxxxvii., &c.

Pelopium, discovered by Rose, in 1846, and supposed to accompany niobium (columbium). Rose has shown that pelopic acid is convertible into niobic acid, and this into hyponiobic acid. (*Pogg. Ann.*, lxix. and xc.)

Ilmenium, discovered in 1846, by Hermann. (*Journ. Pr. Chem.*, xxxviii. and xl.; also *Pogg. Ann.*, lxxiii.)

Aridium, discovered in 1850, by Ullgren. (*Journ. Pr. Ch.*, lii.; *Ann. Ch. Pharm.*, lxxvi. and lxxxviii.)

Donarium, discovered in 1851, by Bergmann. (*Ann. Ch. Pharm.*, lxxx. and lxxxiv.)

Thalium, discovered in 1852, by Owen. (*Am. J. Sci.*, (2) xiii., xvi., and xvii.)

Nameless metal of platinum group, discovered by Genth, in 1853. (*Am. J. Sci.*, (2) xv.)

Dianum, extracted from tantalite from Finland, by von Kobell, (1860). H. Rose questioned its identity, also Sainte-Claire Deville and Hermann. Von Kobell distinguished it from niobic and tantalic acids, by the formation of a deep blue solution, when treated with tin and hydrochloric acid. (*Ann. Ch. Pharm.*, cxiv., and cxxxvi.)

Wasium, discovered by Bahr, in 1862. (*Pogg. Ann.*, cxix., 572; *Journ. Pr. Ch.*, xci., 316.)

Nameless earth of the calcium group, Dupré, 1861.

Nameless metal of platinum group, Chandler, 1862. (*Am. J. Sci.*, (2) xxxiii.)

Jargonium; under this head are collected the various oxides supposed to accompany zirconia; it appears that six chemists haze independently suspected the compound nature of zirconia, as follows:—

(1.)	*Norium*	in 1845,	by Svanberg.
(2.)	*Nameless earth*	in 1854,	,, Sjögren.
(3.)	*Nameless earth*	in 1864,	,, Nylander.
(4.)	*Nigrium*	in 1866,	,, Church.
(5.)	*Jargonium*	in 1869,	,, Sorby.
(6.)	*Nameless earth*	in 1869,	,, Loew.

The references are as follows:—

(1.) *Bers. Jahresb.*, xxv.; *Journ. Pr. Ch.*, lvii. and xcvii. (2.) *Journ. Pr. Ch.*, lv. and lvii. (3.) *Acta Univers. Lundensis*, 1864. (4.) CHEM. NEWS, 1869. (5.) *Idem.* (6.) *Annals. N. Y. Lyc. Nat. Hist.*, ix., 211.

Summing up all the reactions by which these unknown oxides are distinguished from zirconia we have the following table.

(1.) Great variation in atomic weight of oxide. Svanberg.
(2.) Solubility of oxide in oxalic acid. Svanberg, Sjögren, Loew.
(3.) Solubility of chloride in hydrochloric acid. Svanberg and Forbes.
(4.) Precipitation by ferrocyanide of potassium. Sjögren.
(5.) Insolubility of tartrate in tartaric acid. Forbes.
(6.) Solubility of double potassium sulphates. Nylander.
(7.) Variation in nature of sulphates. Loew
(8.) High. sp. gr. of oxide (5·5 instead of 4·3). Sjögren.
(9.) Black absorption bands of spectrum. Church, Sorby.

(2.) Some misapprehension exists on the second point, owing to the fact that most text-books state that zirconia is *insoluble* in oxalic acid, whereas, Berlin, in 1853, showed, on the contrary, that zirconia is readily and completely *soluble* in oxalic acid.

In Finkener's revised edition of H. Rose's work, the error contained in earlier editions is corrected.

(8.) Berlin found the sp. gr. of zirconia from cataplèite =4·9, precisely the mean of the other two.

(9.) The manner in which Sorby has explained the last point is familiar to all.

Preparation of Barium Chlorate.—Brandau has proposed the following simple method for the preparation of barium chlorate:—Commercial crystallised aluminium sulphate, sulphuric acid, and potassium chlorate, in the ratio of one molecule of each of the two former to two of the latter, are mixed with water to the consistence of a thin paste, warmed for half an hour on the water-bath, allowed to cool completely, and treated with alcohol in excess. Upon filtering, and neutralising with barium hydrate, barium sulphate and some aluminium hydrate are precipitated, and barium chlorate remains in solution. The alcohol is distilled off, and the filtrate on evaporation yields crystals of the pure barium chlorate. The only precaution necessary is to have the aluminium sulphate and the sulphuric acid in slight excess.—*Ann. Ch. Pharm.*, cli., 361. *Am. Journ. Sci.*, No. 148.

ON THE

PRECIPITATION AND DETERMINATION OF THE METALS OF THE MAGNESIUM GROUP IN THE FORM OF OXALATES.

By W. GOULD LEISON.

Professor Gibbs has recently* called attention to the fact that a number of metallic oxides may be completely precipitated from their neutral solutions by means of oxalic acid, provided that a large excess of alcohol be also added. As it is not easy to obtain precise quantitative results by igniting the oxalates so precipitated, in consequence of the extreme subdivision of the resulting oxides, Professor Gibbs suggested the employment of potassic hypermanganate for the combustion of the oxalic acid—a method which, as is well known, gives excellent results in the case of calcic oxalate precipitated in the ordinary manner. The following investigation was undertaken for the purpose of testing this method of analysis:—

Cadmium.—Cadmic sulphate was dissolved in the least possible quantity of water, oxalic acid added in excess, and then a large quantity of strong alcohol. The resulting oxalate was beautifully crystalline, and the precipitation was so complete that SH_2 gave, in the filtrate, a scarcely perceptible yellowish tinge. The oxalate was washed with alcohol by Bunsen's method, and dried at 110° C., until every trace of alcohol was expelled. The filter was then pierced with a glass rod, and the cadmic oxalate washed into a flask with hot diluted sulphuric acid. A few cubic centimetres of strong sulphuric acid were then added, and the hot solution titrated with potassic hypermanganate. In this manner, four experiments gave 44·19 per cent, 44·65 per cent, 44·88 per cent, and 44·27 per cent of cadmium, as computed from the oxalic acid. These results are all much too high, and show that the acid had acted sensibly upon the filter. Two other experiments were then made. In the first, a hot solution of ammonic sulphate was used as a solvent for the oxalate; in the second, hot dilute chlorhydric acid was employed. Of the hypermanganic solution employed, 100 c.c. contained 0·1103 gr. of available oxygen.

I. 0·4330 gr. cadmic sulphate required 24·5 c.c. hypermanganate = 43·68 per cent Cd.
II. 0·3724 gr. cadmic sulphate required 21·1 c.c. hypermanganate = 43·74 per cent Cd.

The received formula, $3CdSO_4+8H_2O$, requires 43·75 per cent. In these two analyses the filters were not broken.

Barium.—Baric chloride gave extremely variable results in my first experiment, notwithstanding the fact that the barium is completely precipitated by oxalic acid and alcohol. The resulting oxalate, after washing and drying, was not completely decomposed by sulphuric acid, which appeared to form a crust of baric sulphate upon the crystals of the oxalate. This difficulty was finally overcome by dissolving the baric oxalate in chlorhydric acid and diluting the solution largely. In this manner—

0·6505 gr. baric chloride required 80 c.c. hypermanganate = 56·21 per cent Ba (100 c.c. hypermanganate solution contained 0·053 gr. available oxygen). The formula $BaCl_2+2H_2O$ requires 56·15 per cent Ba.

Strontium.—To avoid the use of paper filters, so as to be able to employ sulphuric acid as a solvent, I resorted to sand filters. A light funnel was ground truly conical near the throat; a little pear of glass with a long stem was then dropped into the funnel, stem upward. In this manner, a valve was formed impassable to the sand laid upon the ball of the glass, but allowing liquids to pass freely. By means of the stem, the valve could be lifted from its seat, and the sand and precipitate washed together into a flask, after careful drying. With this arrangement:—

0·4292 gr. strontic nitrate required 47·8 c.c. hypermanganate = 48·90 per cent SrO.
0·3657 gr. strontic nitrate required 40·8 c.c. hypermanganate = 48·90 per cent SrO. (100 c.c. hypermanganate solution contained 0·1099 gr. available oxygen.)

The formula $Sr(NO_3)_2$ requires 48·93 per cent SrO. Sulphuric acid only was used to decompose the oxalate.

Calcium.—Iceland spar was dissolved in chlorhydric acid, and the solution treated with oxalic acid and alcohol. The filtrate contained calcium. When, however, the solution was evaporated to dryness before adding alcohol, and the oxalate was washed on a sand filter, no traces of calcium could be detected in the filtrate. In this manner—

0·5090 gr. $CaCO_3$ required 70·6 c.c. hypermanganate = 56·10 per cent CaO. (100 c.c. hypermanganate corresponded to 0·11559 gr. oxygen.)
0·5590 gr. $CaCO_3$ required 77·5 c.c. hypermanganate = 56·08 per cent CaO. (100 c.c. hypermanganate corresponded to 0·11495 gr. oxygen.)

The formula requires 56·00 per cent CaO. Sulphuric acid only was employed.

Magnesium.—When magnesic sulphate is treated with oxalic acid, the mixture evaporated (but not to dryness), and alcohol added, the filtrate is perfectly free from magnesium. In this manner—

0·3243 gr. $MgSO_4+7H_2O$ required 39·6 c.c. hypermanganate = 16·18 per cent MgO.
0·3949 gr. $MgSO_4+7H_2O$ required 48·4 c.c. hypermanganate = 16·25 per cent MgO.

In these analyses, the oxalate was collected on a paper filter, and washed into the flask with water after piercing the filter, which was washed with cold dilute sulphuric acid. The formula requires 16·26 per cent.

Zinc.—Zinc is completely thrown down from its sulphate by the unmodified process. The oxalate forms an extremely fine powder. A sand filter and warm dilute sulphuric acid were employed.

0·9301 gr. sulphate required 47·1 c.c. hypermanganate = 28·14 per cent ZnO.
1·0788 grs. sulphate required 54·6 c.c. hypermanganate = 28·15 per cent ZnO.

The formula requires 28·22 per cent ZnO.

Cobalt.—Perfectly pure anhydrous cobaltous chloride was prepared by igniting chloride of purpureo-cobalt. The chloride was then precipitated by oxalic acid and alcohol, collected on a sand filter, and digested with dilute sulphuric acid. The solution was intensely red. A solution of nickeliferous sulphate was then added, until the red colour disappeared and a faint smoky hue took its place.* In this manner—

0·4292 gr. $CoCl_2$ required 47·8 c.c. hypermanganate = 45·30 per cent Co.
0·3657 gr. $CoCl_2$ required 40·8 c.c. hypermanganate = 45·37 per cent Co.

The formula requires 45·38 per cent (Co = 59).

Nickel.—In the case of nickeliferous sulphate, it was found necessary, after adding the oxalic acid, to concentrate the mixture on a water-bath before adding alcohol, and then further digest for about half an hour, replacing the alcohol as fast as it evaporated. The oxalate was collected on a paper filter, and, after washing, dissolved in ammonia on the filter. The filtrate was then acidified

* *Amer. Journ. Sci.*, vol. xliv., p. 213.

* Compare, as regards this method, W. Gibbs, *Amer. Journ. Sci.*, vol. xiv., p. 204.

with sulphuric acid, and the colour finally discharged by a solution of cobaltous sulphate. In this manner—

0·9585 gr. nickeliferous sulphate required 42·2 c.c. hypermanganate = 28·57 per cent NiO.
1·0287 gr. nickeliferous sulphate required 45·3 c.c. hypermanganate = 28·58 per cent NiO.

The formula $NiSO_4 + 6H_2O$ requires 28·24 per cent NiO(Ni = 58), but it is very difficult to obtain the sulphate in a perfectly definite state of hydration.

Manganese.—Although manganese is completely precipitated from its soluble salts by oxalic acid in the presence of alcohol, my results with the method have not been satisfactory, owing, as I suppose, to my not having a definite salt for analysis. The following analyses show, at any rate, that closely corresponding results can be obtained when the same substance is taken:—

0·3760 gr. manganous oxalate required 30·50 c.c. hypermanganate = 38·38 per cent MnO.
0·4013 gr. manganous oxalate required 32·55 c.c. hypermanganate = 38·38 per cent MnO.

The salt $2C_2MnO_4 + 5H_2O$, when dried in air, requires 37·77 per cent MnO, while the salt analysed was dried at 100° C. In like manner, two analyses of a sulphate, which had probably absorbed a little water, gave 45·28 per cent and 45·29 per cent of MnO. The crystallised sulphate, $MnSO_4 + 7H_2O$, requires 46·67 per cent.

Iron.—Good results could not be obtained by the application of this method to the determination of iron, but I am not at present able to assign the reason of the failure in this case.

To complete my work, it remains for me to point out the applicability of the process to the determination of the whole quantity of oxygen contained in a number of bases present together in solution—a problem which is sometimes of interest.

Sulphates of manganese, magnesium, nickel, cobalt, cadmium, and zinc, in undetermined quantities, were dissolved together in water, and the solution well shaken. Four portions, of 100 c.c. each, were then taken, and the acid determined in each by baric chloride. In two other equal portions, the bases were precipitated as oxalates and titrated as above. The oxygen in the acid was then calculated from the amount of baric sulphate. In this manner it was found that the oxygen in the acid was, to that in the mixed bases, as 3 to 1 very nearly, the precise ratio being, in the one case, as 0·054 is to 0·018, and in the other as 0·055 is to 0·018. Another experiment was made with a crystallised dolomite containing 0·45 per cent of insoluble residue. The lime, magnesia, and iron were precipitated together, and titrated as oxalates; the carbonic acid was determined by ignition. In this manner, the oxygen of the acid was found to be, to the oxygen in the bases, as 34·48 is to 17·28. The bases, after ignition, amounted to 52·41 per cent.

In another experiment with a dolomite from a different locality, containing 0·13 per cent of insoluble residue, the oxygen ratio was found to be as 34·56 is to 17·28, the bases amounting to 52·33 per cent. If we calculate the relative quantities of calcic and magnesic carbonates from the sum of the two oxides in the last analysis, and the oxygen found by titrating the oxalate, we find—

$MgCO_3$	42·77
$CaCO_3$	57·07
Insoluble residue	0·13
	99·97

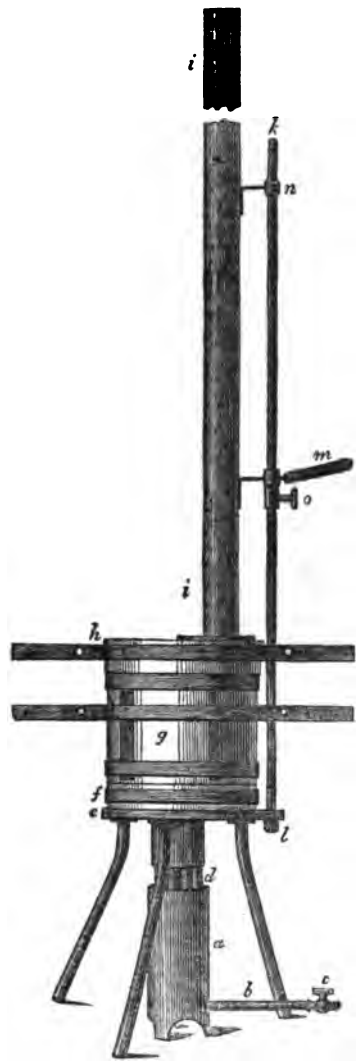
The small quantity of ferrous oxide present being neglected. This analysis will serve to show the applicability of the method in indirect analyses. My results appear to me to furnish a generalisation of the use of potassic hypermanganate, which will be received with favour by those who employ this reagent frequently in volumetric analyses.

DESCRIPTION OF A GAS FURNACE FOR CHEMICAL OPERATIONS AT A WHITE HEAT, WITHOUT THE AID OF A BLOWING MACHINE.

By CHARLES GRIFFIN.

FUSIONS at a white heat can be readily effected by a gas furnace supplied with air by a blowing machine. But a furnace of that description has several defects:—The blowing machine is expensive; it is cumbersome in a laboratory; it demands constant labour during a fusion;

FIG. 1.



and it produces so much noise as to interrupt every kind of quiet work.

The furnace to be described in the following notes is free from these defects. It is small and portable, easily put together and taken asunder. It demands no blowing machine, and only a small chimney. It acts without smoke, or dust, or noise. Its heating power is sufficient to raise a 4½-inch clay crucible, filled with metal, to a

white heat. Cast-iron can be fused in it and cast into ingots of the following weights :—

A. Commencing with the furnace cold—
An ingot of 2 lbs. in 70 minutes.
An ingot of 3 lbs. in 90 minutes.
An ingot of 4 lbs. in 2½ hours.

B. Commencing with the furnace hot—
An ingot of 2 lbs. in 40 minutes.
An ingot of 2½ lbs. in 50 minutes.
An ingot of 5 lbs. in 2½ hours.

Silver, gold, and copper can be fused in larger quantities and in less time.

The furnace is represented by Fig. 1. Its height, including the stool, is about 2 feet. The external diameter is 8 inches. It consists of the following parts :—

a is a brass cylinder, open at the bottom, and into the top of which sixteen Bunsen's burners are fixed ; gas is supplied by the pipe, *b*, regulated by the stop-cock, *c*. A jacket surrounds the upper part of the Bunsen's burners, but is cut away at the bottom, *d*, in order to permit air to pass up between the burners.

The consumption of gas by this compound burner when at work in the furnace is 33 cubic feet per hour.

e is an iron stool, which supports the furnace and also the iron rod, *k*, to which the chimney is attached.

f is a fire-clay sole plate, shown in section by Fig. 2. The system of burners is closely fixed in the perforation of this plate.

Fig. 2.

g is a cylinder of fire-clay, shown in section by Fig. 3. It measures 6 inches in height, 8 inches in external diameter, and 5 inches in bore. The crucible to be heated is supported on a perforated plumbago cylinder, represented in section by Fig. 3, and in perspective by Fig. 4. In

Fig. 3.

Fig. 4.

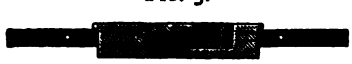
order to secure the greatest degree of fusing power, the bottom of the crucible, *c*, Fig. 3, should be fixed at 1-inch or 1½-inch distance from the face of the bundle of gas-burners, *a*, Fig. 1. For this purpose, the two plumbago cylinders supplied with the furnace differ ½ inch in height.

The crucible must be conical, not barrel-shaped, in order that the flame, after striking the crucible, may have space to escape through the holes in the plumbago cylinder.

The distance between the outside of the plumbago cylinder and the inside of the furnace cylinder, that is to say, the space marked *s*, *s*, in Fig. 3, must not exceed ¼ an inch all round. Increase of space here lessens the heating power of the furnace.

h, Fig. 1, is the dome or roof of the furnace. It is represented in section by Fig. 5. This figure shows that the

Fig. 5.



flame, in rising from the body of the furnace, is bent twice at a right angle before it passes into the chimney.

i, *i*, Fig. 1, is an iron chimney, which measures 4 feet in length, and 2 inches in diameter ; *k* is a vertical iron rod, screwed into the stool, *e*, of the furnace at *l*. This chimney is movable by the handle, *m*. At *n* there is a guide, and at *o* a stop. By this arrangement the chimney can be set on the furnace, or moved aside, with facility. This movement is sufficient when the furnace is used for simple fusions, or when no deleterious gases are driven off ; but when arsenic, sulphur, &c., are expelled during an operation, and the entire apparatus cannot be placed under a hood or fixed chimney, then the upper end of the chimney, *i*, *i*, should be passed into the vertical branch of a knee-piece, the horizontal branch of which is connected with a fixed flue, and the chimney, *i*, *i*, should be raised within the knee-piece by moving upwards the stop, *o*, on the rod, *k*, A rise of about 6 inches is necessary to make room for the removal of the dome, *h*, and the cylinder, *g*, on dismounting the furnace to remove a crucible. It is necessary to see that the draught of the fixed chimney is not too powerful.

The method of mounting crucibles exhibited by Fig. 3 serves for 4½ inch and for 4 inch crucibles, but not for smaller sizes. A 3 inch crucible slips through the plumbago cylinder and spoils the draught, and if a smaller cylinder is used, the spaces, *s s*, Fig. 3, become so wide that the effective heat of the furnace is greatly diminished. Hence it is necessary, when small crucibles are to be used, to support them on a grate made of fire-clay, the best form of which is represented by Fig. 6. Its diameter is

Fig. 6.

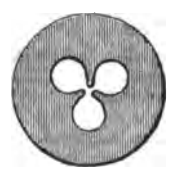


Fig. 7.

6 inches. This grate is placed upon the sole plate of the furnace. The crucible is set upon it, and is surrounded by a smaller fire-clay furnace cylinder, namely, by one that measures 5 inches in height, 6 inches in external diameter, and 4 inches in bore. The dome, Fig. 5, or *h*, Fig. 1, is used with the small cylinder, Fig. 7, as well as with the large cylinder, Fig. 3.

Platinum and porcelain crucibles can be heated in the small furnace, Fig. 7, enclosed in fire-clay crucible cases.

The fire-clay grate, Fig. 6, can be used with the large cylinder, Fig. 3 ; and, in crucibles supported by it, as much as 3 lbs. of cast-iron can be melted ; but the operation requires an extra half-hour of ignition beyond that required when the crucible is supported by the plumbago cylinder, Fig. 4.

When the furnace is mounted for use with the large cylinder, Fig. 3, three bronze pennies are put on the sole plate, *f*, Fig. 1, to support the cylinder, *g* ; when the grate is used, the three pennies are put under the extreme edge of the grate. These pennies leave a space for the admission of air.

Operations that succeed at moderate temperatures, such as the fusion of zinc in an iron pot or ladle, are performed without using the dome and chimney. The vessel to be heated is to be placed on the inner cylinder of Fig. 3.

The furnace body, Fig. 3, and the dome, Fig. 5, are provided with iron handles. These never become very hot, not even when the furnace contains 3 lbs. of melted iron. The operator's hands are sufficiently protected when lifting these pieces by a couple of folds of thick cloth, or brown paper. The small cylinder, Fig. 7, is handled by the same bow tongs that serve to lift the hot crucibles.

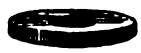
Access to the crucible in the furnace is gained at any moment by turning aside the chimney, and lifting the dome, *h*, Fig. 1. When the crucible is to be removed, the dome is first taken from the furnace, and placed on a circular plate of fire-clay ; the outer cylinder is next lifted off, and placed on a similar plate of fire-clay. The crucible can then be removed by the bow tongs. If the furnace is to be immediately used for a second operation, the

cylinder should be covered with a third clay plate, to retard the loss of heat while the crucible is being replaced by another.

GAS MUFFLE FURNACE.—When the furnace cylinder, *g*, Fig. 1, is replaced by an oval furnace body that contains a muffle, as represented by M in Fig. 8, all other

FIG. 8.

FIG. 9.



parts of the furnace remaining as represented by Fig. 1, the usual muffle operations can be performed, such as cupellation, the roasting of ores, the combustion of organic bodies for their ashes, the burning of filters, &c. The muffle belonging to this furnace measures 7 inches in length, 3¼ inches in width, and 2¼ inches in height. It requires a bright red heat, sufficient to melt silver, gold, and copper. This heat can be kept steady and uniform for hours; and being free from dust or soot, is particularly suitable for such operations as annealing.

Nothing new is offered in the burner of this apparatus, for it is merely a bundle of Bunsen's jets; nor in the fire-clay fittings, which are copied from Griffin's Blast Gas Furnace; but a few words may be said on one or two other points.

The first relates to the supply of gas and air. The greatest heat is produced when coal-gas is burnt in the presence of as much air as entirely decomposes and oxidises it; that is to say, when one volume of gas is mixed with ten or twelve volumes of air; but when gas is mixed directly with so large a quantity of air, it becomes explosive, and cannot be used as fuel. It is consequently necessary, in the management of a gas furnace, to supply the air, certainly as rapidly as the combustion demands, yet so gradually as to avoid explosions. In arranging the furnace now under discussion, the gas is supplied in excess, and the air in three successive doses:—the first quantity at the bottom of the cylinder, *a*, Fig. 1; the second at the openings, *d*, Fig. 1; and the third, where the three bronze pennies are place on the sole plate, either under the cylinder, Fig. 3, or the grate, Fig. 6. By this arrangement, the gas is fully supplied with air, while the chance of explosion is almost entirely obviated. When, however, the furnace is in operation at a white heat, if the gas supply-pipe is *pinched*, an explosion occurs, because, under the action of the hot furnace and the chimney, the air is immediately brought into excess. In such a case, as soon as an explosion is heard, the gas should be turned off, the chimney be moved aside, and the opening in the dome of the furnace be closed by a crucible cover. The draught of air is thus stopped. If now the gas is turned on fully, it takes fire properly in the body of the furnace, and, the chimney being replaced, the operation proceeds as usual.

The second point to be noticed is the form of the flue in the furnace roof, or dome, Fig. 5. By this contrivance, the rising current of flame and gas is bent twice at a right angle, and an obstruction is produced between the body of the furnace and the chimney, without which the gases would escape too readily into the chimney, and burn there instead of in the furnace. If the roof, Fig. 5, is replaced by a flat perforated plate similar to Fig. 9—the same furnace and chimney being used—the diminution of heating power is very considerable.

The progress of an ignition is judged of chiefly by the colour of the fire, as seen through the crevices of the furnace between the pieces *f* and *g*, and *g* and *h*, in Fig. 1. The eye soon learns to distinguish the colour which indicates an *iron-melting* heat.

The proper admixture of gas and air is judged of from the colour and quantity of flame which passes up the chimney. To enable the operator to see this flame, three small holes are bored in the chimney. The flame is never seen at the upper hole, unless the supply of gas is too large; but it is always visible at both the lower holes. As there are no valves to regulate the supply of air, due attention must be paid to the supply of gas.

MISCELLANEOUS.

Chair of Chemistry at St. Bartholomew's.—We learn that Mr. J. Alfred Wanklyn, Dr. Russell, F.R.S., Dr. Dupré, and Mr. Maxwell Simpson are spoken of as candidates for the above vacant chair.

The Chemical Society.—The first meeting of the session will be held on Thursday, November 3rd, at 8 o'clock, when Mr. A. H. Elliott will read a paper on "The Analysis of Cast-Iron."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1870.

From the report of the latest meetings of this Society, we learn that Mr. Roberts, chemist to the Royal Mint, London, has been elected a Member of the Society. This number contains the following original papers and memoirs:—

Action of Sulphuric Acid on Organic Chlorides which contain Nitrogen.—A. Oppenheim.—The author states that, after having previously studied the action of sulphuric acid on organic chlorides, he proceeded to the investigation of the action of that acid upon chlorides which also contain oxygen. He found that, generally speaking, there is no difference in this action; because, according to the degree of saturation of the substance, it either combines directly with H_2SO_4, or Cl is driven off in the form of HCl, and, in its stead, H_2SO_4 combines with the substance. The molecule, HSO_4, is readily replaced by hydroxyl. As an instance, the author quotes the monochlorhydrine of glycol, $C_2H_4.OH.Cl$, which behaves exactly as chlorethyl, C_2H_5Cl, there being formed, while HCl is given off, the conjugate acid, $C_2H_4.OH.SO_4H$. The lengthy paper contains, further, the account of a series of experiments made with benzoyl-chloride, which, when acted upon by sulphuric acid, yields a monobasic sulphobenzoic acid, $C_6H_5CO.SO_4H$. Acetyl-chloride, and the chlorides of phthalic acid, are acted upon in the same manner by sulphuric acid.

Sulphobenzoic Acid.—E. Ador and A. Oppenheim.—This paper contains a detailed accoun of a comparative investigation instituted with the sulphobenzoic acid mentioned in the foregoing paper, and with the same acid as obtained when prepared by a different method. The result is, that the identity of these bodies is fully established.

Nitro-Naphtoë Acid.—O. Küchenmeister.—After referring to the researches made on this subject by MM. Schäffer, Wichelhaus, Merz, Mühlhauser, and others on this subject, the author treats, at great length, on α and β naphtoë acid, both of which are readily nitrited. The α nitro-naphtoë acid fuses at 194°, the β acid at 228°.

Products of the Distillation of Coal-Tar which have a High Boiling-Point.—C. Graebe and C. Liebermann.—This memoir treats on pyren, $C_{16}H_{10}$, a body not to be confounded with the pyren of Laurent,

who, undoubtedly, had not obtained a pure substance, but a mixture of several hydrocarbons. The pyren here alluded to is a solid body, perfectly colourless when chemically pure; difficultly soluble in alcohol when cold, more readily so when boiling, and best soluble in benzol, ether, and sulphide of carbon; fuses at 142°. Pyren is characterised by combining directly with picric acid when solutions of these bodies are mixed together; this compound, $C_{16}H_{10}+C_6H_2(NO_2)_3OH$, crystallises in long needle-shaped red-coloured crystals. The memoir further gives an account of the substitution-products of pyren; nitro-pyren, $C_{16}H_9(NO_2)$; pyren-chinon, $C_{16}H_8(O_2)''$; bibrom-pyren-bromide; tribrom-pyren, $C_{16}H_7Br_3$; and on the constitution of pyren expressed by a lengthy and very picturesque formula.

On Phenyl-Ether and Diphenyl-Oxide.—W. Hoffmeister.—Phenyl-ether is a solid, colourless body, having an agreeable aromatic smell; fuses at 28°; boils at 248°; is insoluble in water, but readily soluble in alcohol and ether. When this ether is acted upon by strong sulphuric acid, heat being applied, the result is the formation of phenyl-oxide bisulpho acid. The baryta salt of this acid—

$$C_{12}H_8O\left\{\begin{matrix}SO_2O\\SO_2O\end{matrix}\right\}Ba,$$

is readily soluble in water, but not in alcohol and ether. Diphenyl-oxide.—This body was prepared by the author, and its properties investigated with the view to compare his results with those obtained by M. Lesimple (see *Ann. der Chem. und Pharm.*, vol. cxxxviii., p. 375). The author confirms the correctness of the researches published in the periodical just quoted, and states that the formula of diphenyl-oxide is $C_{12}H_8O$.

Quadri-Phenylised Ethylen, a Derivative from Benzo-Phenon.—Arno Behr.—The author describes the preparation of benzophenon from benzoate of lime; and also the conversion of the benzophenon into a chloride of that substance, by heating it along with pentachloride of phosphorus to 180°, in a sealed tube for about eighteen hour's time. This chloride yields, when decomposed by finely-divided metallic silver, a new body, the quadri-phenylised ethylen, $C_{26}H_{20}$.

Dibrom-Benzol.—V. Meyer.—This paper contains a discussion on the position of the atoms of bromine in crystallised dibrom-benzol.

Miscellaneous Researches made in the Laboratory of Berlin University.—Dr. A. W. Hofmann.—This memoir is divided into the following sections:—On some derivatives of the isobutylic alcohol; isobutyl-benzol and isobutyl-anisol; action of bromine on the aldehyde of the ethyl series; contribution to the history of trichlor-acetic acid and trichlor-crotonic acid; action of cyanic acid on acroleine; action of chlorine upon hydrocyanic acid in alcoholic solution. The subjects herein alluded to are the results of the labours of several students who attend Dr. Hofmann's classes.

Miscellaneous Researches.—Dr. A. W. Hofmann.—This series contains the following subject-matter:—Aldehyde green—The formula of this substance is $C_{28}H_{37}N_3S_2O$; it may be considered as formed by the union of 1 molecule of rosaniline, 1 of aldehyde, and 2 of sulphuretted hydrogen, which, by the action of aldehyde upon rosaniline in the presence of hyposulphite of sodium, may probably be according to—

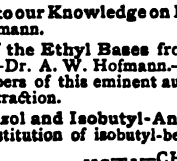
$$C_{20}H_{19}N_3+C_2H_4O+2H_2S=C_{28}H_{37}N_3S_2O.$$

(The eminent author desires it to be stated that he does not consider this formula as expressing the true composition of the aldehyde green, but merely an approximative expression; his researches on this subject are not yet complete.) Contribution to the history of the ethylen bases. Action of cyanogen on aniline. Action of cyanogen upon triphenyl-guanidine. New series of cyanic acid ethers. New method of formation of isonitrile. Diagnosis of primary, secondary, and tertiary amines. Delicate test for chloroform.—This test is based upon the fact that, when chloroform is mixed with aniline and an alcoholic solution of caustic soda, a very strong reaction takes place, and isonitrile is generated, which is readily recognised by its peculiarly characteristic smell; this reaction is so delicate that, when 1 part of chloroform is mixed with from 5000 to 6000 parts of alcohol, the first-named substance is readily detected. Reagent for cyanuric acid when present in diluted solutions and in very small quantity.—This test is based upon the very difficult solubility of the sodium cyanurate in a hot and concentrated soda solution. Action of acetic acid upon phenyl oil of mustard (*phenyl senföl*).

Contribution to our Knowledge on Phenyl-Xantho-Genamide.—Dr. A. W. Hofmann.

Separation of the Ethyl Bases from each other by means of Oxalic Ether.—Dr. A. W. Hofmann.—These memoirs, and most of the preceding papers of this eminent author, are too lengthy to admit of any useful abstraction.

Isobutyl-Benzol and Isobutyl-Anisol.—J. Riess.—This memoir treats on the constitution of isobutyl-benzol—



on para- and orthonitro-isobutyl-anisol; and on the question, how the group NO_2 is placed in some of these nitro-substitution compounds.

Contribution to the History of Trichloro-Acetic Acid and Trichloro-Crotonic Acid.—W. E. Judson.—This exceedingly lengthy monograph is divided into the following sections:—Trichlor-acetanilide; trichlor-aeettoluide; trichlor-acetic acid isobutyl-ether; trichlor-crotonic acid; trichlor-crotonic acid ethyl-ether; chloride of trichloro-crotonic acid; trichloro-crotonamide; decomposition compounds of trichloro-crotonic acid; action of pentachloride of phosphorus on croton-chloral.

Products of the Action of Chlorine upon Aldehyde.—G. Krämer.—This paper contains a lengthy discussion and refutation of observations made by M. Wurtz on the author's labours on this subject, as published some time ago.

Methods of Water Analysis.—A. Müller.—Second paper on this subject, treating of the estimation of sulphuric acid and chlorine.

Amido-Toluylen-Sulpho Acids.—H. L. Buff.

Molecular Heat of the Hydrates of Sulphuric Acid, and on the Heat of Combination Evolved by their Admixture with Water.—L. Pfaundler.—A series of figures arranged in tabulated form.

Uratonil.—Dr. Krejci.—The subject referred to is the name given to a new mineral first found near Sedlec, Bohemia, but lately also near Welsendorf, Bavaria. This mineral does not fuse when heated in the blowpipe flame; it consists, in 100 parts, of—Water, 12·666; silica, 13·781; phosphoric acid, 0·448; sesquioxide of uranium, 66·752; alumina and peroxide of iron, 0·511; lime, 5·273. Formula—

$$3U_2O_3.CaO.3SiO_2+9HO.$$

Cotton Dressing.—O. Meister.—The author, residing at Zürich, Switzerland, states that a parcel of white calico, of English manufacture, was found, on analysis, to be dressed to the extent of over 25 per cent of the weight of the fibre, while 5 per cent of this dressing consisted of mineral matter. The calico was sold at a price below the value of the yarn it was made of.

Adulterated Starch.—O. Meister.—A sample of starch sent (not, however, from England, but from Germany) to a dresser of calicoes, &c., at Zürich was found to be adulterated with 16 per cent of gypsum.

Establishment of a Chemical Society at Zürich.—The last-named author communicates that (now some months ago) the company hitherto existing under the title of Chemical Harmonica has been converted into a regularly-established chemical society, under the presidency of Dr. Wislicenus. The papers read at this Society and the communications made will be published in the above-named periodical until further notice. The Society lost, a few weeks after having been inaugurated, one of its foremost members, by the death of Dr. A. P. Bolley, whose biography forms the concluding pages of this number.

Polytechnisches Journal von Dingler, second number for September, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Detection of Arsenic in Sulphuric and Hydrochloric Acids, in Subnitrate of Bismuth, and in Antimonio-Tartrate of Potassa.—Dr. A. Bethendorf.—Take a thoroughly clean and dry test-tube, of not too narrow a bore; put into it as much pure protochloride of tin as can be placed on the point of a knife; next add from 4 to 6 c.c. of pure hydrochloric acid (containing 25 per cent of real acid, sp. gr. about 1·12); add, after this, gradually, from 2 to 3 c.c. of the sulphuric acid to be tested, taking care to move the test-tube very gently. If a white precipitate ensues, the addition of a few drops of the hydrochloric acid will be required to restore the liquid to perfect limpidity. If no arsenic is present, the liquid remains clear and colourless, even after standing for a time; but, if even a trace of arsenic is present, the fluid becomes at first yellowish, next brownish coloured, and at last the metallic arsenic is deposited as a deep greyish brown flocculent substance. Even with only 1-500,000th part of arsenious acid a colouration ensues. It is essential that, when the sulphuric acid is added, the liquid should become hot; if, therefore, that acid is too dilute to cause heating, the test-tube and contents should be warmed over a spirit flame. The testing of hydrochloric acid only differs in this particular: that, instead of taking, as above stated, pure hydrochloric acid, the acid to be tested is taken, and pure concentrated sulphuric acid is applied. The testing of the subnitrate of bismuth is carried out in the following manner:—About ½ a grm. of the subnitrate is placed in a test-tube; a quantity of 1 c.c. of pure and concentrated sulphuric acid is next added, to expel the nitric acid. After this has been driven off, the tube being kept in a vertical position, from 4 to 5 c.c. of pure hydrochloric acid are added; when the liquid has become quite clear, about 1·5 to 2 grms. of pure protochloride of tin are added; after this salt has been dissolved, about 3 c.c. of strong and pure sulphuric acid are added; and, if the mixture does not then become very hot, it is heated just to the boiling-point. The colouration and precipitation of arsenic above described take place after a shorter or longer time, according to the quantity of that substance which is present; but it ought, of course, to be absent. The testing of tartar emetic is effected in the following manner:—As much tartar emetic as can be carried on the point of a large-sized knife, and twice as much protochloride of tin, are placed in a wide test-tube; 4 to 5 c.c. of the pure hydrochloric acid above alluded to are added; and, next, 2 to 3 c.c. of pure concentrated sulphuric acid. If required, the mixture is heated. Neither the oxides of bismuth nor antimony are reduced to the metallic state by this reaction.

Solubility of Sulphur in an Aqueous Solution of Carbonate of Soda and in Linseed Oil.—Dr. J. J. Pohl.—The author experimented with flowers of sulphur, previously well washed and dried at 100°, and with an aqueous solution of pure anhydrous carbonate of soda containing 5·6 per cent of salt. Sulphur was found to be insoluble in that solution at 25°; but, when the sulphur was digested with the aforesaid solution, heated to 100° for a period of ten hours, it was found, on testing the soda solution, that the quantity of sulphate of baryta obtained corresponded, on an average, to a quantity of 0·0676 per cent of sulphur dissolved. The solubility of sulphur in linseed oil increases with the increase of temperature—at 25°, linseed oil dissolves 0·63 per cent of sulphur; at 95°, 2·587; at 130°, 4·935; and at 160°, 9·129 per cent. Linseed oil which has taken up that quantity of sulphur keeps dissolved,

even after having been standing for a fortnight at 20°, 6·9 per cent; and even after ten weeks' time, no more sulphur is deposited than occurs at first.

Occurrence of Raw Sugar which contains Dextrine, and on the Detection and Estimation of that Substance.—Dr. C. Schiebler.—The author states, in this lengthy paper, chiefly the following facts:—That now and then raw beet-root sugar contains dextrine; that alcohol is not an absolute test for the presence of this substance, while iodine in dilute solution is a better test. In order to test for the presence of dextrine in raw sugar, the author proceeds as follows:—13 grms. of the sugar in question are dissolved in 50 c.c. of water. This solution is filtered, and a portion thereof is mixed with about four times its bulk of alcohol at 95 per cent, which, if dextrine is present, produces a milky cloudiness in the fluid. Another portion of the liquid is treated with a solution of iodine, consisting of 0·1 grm. of iodine and 1·5 grms. of iodide of potassium, dissolved in a little water, and next diluted to 100 c.c. This solution, which is of a sherry colour, produces the characteristic colouration (purplish red) if dextrine be present; but, if the sugar solution is alkaline, the first drops of the iodine solution do not produce a colouration at once. The quantitative estimation of the dextrine can only be effected by analysing the sugar, after having been treated with dilute sulphuric acid, and next applying the well-known copper liquid test.

Addition of Poisonous Substances to Bread.—Dr. H. Eulenberg and Dr. H. Vohl.—This paper, too lengthy for any useful abstraction, treats on the adulteration of bread by the addition thereto of sulphate of alumina, alum, and the sulphates of copper and zinc, and on the methods of testing for the presence of these substances in bread.

Application of Tungstate of Soda to form an Elastic Mass.—Dr. Sonnenschein.—When glue, in thick solution, is mixed with tungstate of soda, and hydrochloric acid is added, there is thrown down a compound of tungstic acid and glue, which, at from 30° to 40°, is so elastic as to admit of being drawn out into very thin sheets. On cooling, this mass becomes solid and brittle; but, on being heated, it becomes again soft and plastic. This material has been successfully employed, instead of albumen, in calico-printing, in order to fix the aniline colours upon cotton; the further applications of this substance are in tannin, but the resulting leather becomes as hard and stiff as a plank of wood. The preparation is recommended as a lute or cement.

Journal für Praktische Chemie, No. 15, 1870.

The following original papers and memoirs are contained in this number:—

Relation between the Crystalline Shape and the Chemical Constitution of some Organic Compounds.—Dr. P. Groth.—The continuation and end of this lengthy essay.

Lithiophorite, a Manganese Ore containing Lithia.—A. Frenzel.—The mineral here alluded to was first found, some years ago, in the neighbourhood of Schneeberg (Saxony), and considered as being psilomelan. The author, however, having investigated this substance, gives the following facts about it:—Sp. gr., 3·14 to 3·36; hardness, slightly above that of calcareous spar; colour, bluish black; amorphous; gives off water when heated in a test-tube, and evolves chlorine when heated in the presence of hydrochloric acid; does not fuse when heated before the blowpipe, but imparts to the flame an intensely carmine-red colour; fused along with borax or microcosmic salt, it yields the characteristic tests for manganese. A full analysis of this mineral will be published afterwards; the author now only gives the following particulars:—Lithia, 1·15 per cent; alumina, 15·42 per cent. This mineral is, says the author, a product of decomposition, but, for all that, a new and specific mineral.

Isotrimorphism of Oxide of Tin and of Titanic Acid, and on the Crystalline Form of Zirconia.—G. Wunder.—A crystallographical essay.

Chemical Constitution of the Phosphorus-Platinum Compounds described by MM. A. Cahours and A. Gal in Comptes Rendus (vol. lxx., pp. 897, &c.).—Dr. H. Kolbe.

Isotaurine.—M. Kind.—This paper, a preliminary notice, contains the announcement that the author has discovered a new body, which, on being analysed, led to the following formula:—$C_2(H_4.H_2N)SO_3OH$. He has named it isotaurine, and promises further particulars.

Amido-Sulpho-Phenol.—L. Glutz and L. Schrank.—This paper is also a preliminary notice. The authors describe, at some considerable length, the methods by which they have obtained, from the sulphanilidic acid of the nitrophenyl-sulphuric acid, several other compounds, among these, nitrophenyl-sulphuric acid chloride (*nitrophenyl-schwefelsäure chlorid*), $(C_6H_4NO_4)SO_2Cl$, a crystalline body, insoluble in water, soluble in ether, and also in boiling alcohol, although it becomes partly decomposed thereby, and fuses below 100°. By acting upon this body with metallic tin, the authors have obtained the hydrochloride of the amido-sulpho-phenol, $(C_6H_4NH_2)SH.HCl$.

Bromonitro-Benzol-Sulpho Acid and some of its Derivatives.—F. G. Fricke.—This paper, again styled preliminary notice, contains the following sections:—Action of ammonia upon bromonitro-benzol-sulpho acid; action of potassa upon bromonitro-benzol-sulpho acid; action of aniline upon bromonitro-benzol-sulpho acid.

Water of Crystallisation.—F. von Kobell.—A lengthy monograph on this subject.

Influence which Temperature Exerts on the Molecular Power of some Substances Endowed with the Property of Circular Polarisation.—Dr. C. Tuchschmid.—This very lengthy essay is illustrated with engravings and a series of tables containing a large number of figures.

Pharmaceutische Zeitschrift für Russland, No. 4, 1870.

This number contains the following original papers and memoirs:—

Some Narcotics Used by the Inhabitants of Central Asia.—Dr. Palm.—This paper contains a brief notice on *Buhsa*, a fluid which appears to possess highly intoxicating power; so much even, that, according to the author's statement, the Russian military authorities have been obliged to forbid the preparation of this beverage, which, being in great favour with the troops, and preferred to other spirituous fluids, renders the men unfit for duty in a very short time. *Buhsa* is prepared by the Kirghisen in the following manner:—Millet is rubbed to a pulp with water; and, after having been diluted with more water, and occasionally with mare's milk (this milk is largely used by the inhabitants of Central Asia), the mixture is poured into large stoneware jars, which are tightly corked, and afterwards buried in the soil. The vessels containing the liquid are left imbedded therein for about ten days; and, after having been dug up, the fluid is transferred to glass wine-bottles, which, after having been well corked, are left standing for a few days, and then offered for sale at the rate of from 3 to 5 kopéïks each (6d. to 10d.). The liquid thus prepared exhibits a greyish colour (somewhat akin to thin barley-water), and is turbid, there being a thick sediment in the bottles. On being uncorked, supposing the liquid to be matured, the beverage escapes in a very brisk manner, owing to the large quantity of carbonic acid present. The taste of this fluid is tart and spirituous; but the after-taste is very unpleasant, owing to the presence of fusel oils. Although the ingredients from which this drink (millet beer) is prepared are somewhat innocent, the effects of the imbibing of this fluid upon the system are not by any means mild; these the author refers to the presence of the alcohols of the higher fatty acids, in addition to alcohol, aldehyde, acetic, lactic, valerianic, and traces of fatty acids and their alcohols (viz., fusel oils). Notwithstanding the Russian Government takes all possible measures to prevent the preparation and sale of buhsa, it is a popular drink; and, moreover, its mode of preparation from millet yields a substitute for yeast for baking purposes, and the prepared buhsa is largely applied for that purpose. The author next treats on three kinds of opium. That locally known as Bucharic opium is not the product of Central Asia, but imported overland from Hindostan; the two other kinds (viz., Chinese and Samarkand drugs) were found of good quality. The *Haschisch*, or *Chaschisch*, from *Cannabis indica*, is next alluded to; it is used in various forms, and by the Mahommedan women, in the shape of lozenges, known as *goëlkant*, which literally means yellow sugar, but consisting of sugar, haschisch, cinnamon, ginger, pepper, cloves, and gum.

Analysis of a Crude Potash.—Dr. Palm.—At a distance of 80 werats from Taschikent (the werst is a Russian measure, equal to 1066·78 metres; 104·1555 werats are equal to 1 degree of the meridian) the Kirghise prepare, from various wild plants, a kind of potash which occurs in the trade (in Central Asia) as a hard kelp-like substance, very difficultly soluble in boiling water, and leaving a carbonaceous residue. The author found this substance to contain, in 100 parts:—Carbonaceous matter, 5; soda, combined with carbonic acid, 36·8; chloride of sodium, 7·3; lime, 5·5; potassa, 3·85; magnesia, 1·4; alumina, 0·64; carbonic acid, 26·12; chlorine, 11·26; sulphuric acid, 1·84; silica, 0·05; iron and manganese, traces. The author calls attention to the fact that the large percentage of soda in this material is due to the very generally prevailing impregnation of the soil of the steppes, for thousands of wersts in extent, with carbonate of soda and chloride of sodium. The shrubs and plants which serve to prepare this article are such as can only grow in a similar soil.

Preliminary Notice on the Milky Juice of an Euphorbiaceous Plant.—Dr. Palm.—After referring to some strictly botanical particulars concerning a plant found in the neighbourhood of Taschkent, the author states that the milky juice which this vegetable yields while being cut is at first perfectly homogeneous; but, in a few minutes, more than three-fourths of the bulk of this fluid becomes coagulated—that is to say, the caoutchouc which is nearly always present, in greater or less quantity, in all milky vegetable juices separates, leaving a fluid which exhibits, simultaneously, an ammoniacal and ethereal odour. The caoutchouc, once separated from its menstruum, cannot be united with it any more. The taste of this milky juice is at first mild and oily, but soon leaves an acrid, sharp, burning taste, which even brings on inflammation of the throat. Our readers are reminded that all euphorbiaceous plants are more or less poisonous, while some among them yield the most virulent acrid vegetable poisons we are acquainted with.

No. 5.

This number contains the following original papers and memoirs:—

The Manner in which the Nitrogen is Distributed in the Different Parts of the Black and White Henbane (*Hyoscyamus Niger et Albus*) during the various stages of the Development of these Plants.—E. Thorey.—This lengthy monograph contains the results of a long series of experiments made with the above-named plants, as a whole, and their different parts—viz., roots, leaves, stems, seeds—and at various periods of their growth, with the view to ascertain the partition of the various nitrogenised constituents of these plants at various epochs of their life. The essay is too lengthy, and too much filled with a series of results exhibited in tabulated form, to admit of any useful abstraction, notwithstanding the great value of this labour in a phuto-physiological point of view, as well as in its practical bearing of the applications made of *hyoscyamus* in medicine.

No. 6.

This number opens with and contains no other original paper than—

Treatise on the Various Analytical Methods in Use for the Determination of the Quantity of Tannic Acid present in Catechu, Ratanhia, Kino, and other Drugs.—Dr. Günther.—This exhaustive monograph, the first portion of which is found in this number, and is continued in Nos. 7 and 8, contains a review of all the various methods which have been proposed for the estimation and quantitative determination of the tannic acid present in the commercial substances above referred to, and chiefly applied in dyeing, calico printing, and tanning. The author not only describes the various methods, but has tested the value of each method practically and with great care. Among the results arrived at, and the conclusions drawn from his researches, we quote the following as the most important:—None of the different methods which have been applied for the quantitative estimation of tannic acid answers the purpose completely—that is to say, that a method which yields excellent results with nutgalls is not equally suitable for sumack, cutch, and other similar substances; for the reason that these materials contain either other substances along with tannic acid or specific modifications of the same. We regret that the very great length of this monograph prevents us entering into further details on this subject.

Nos. 7 and 8.

These numbers contain no other original papers than that quoted under No. 6.

No. 9.

This number contains the following original papers and memoirs:—

Contribution to our Knowledge of the Aconite Alkaloids.—Dr. F. A. Flückiger.—This paper treats on the alkaloids contained in several plants known by different botanical names, but all belonging to the species *aconite*. The author distinguishes between aconitine, pseudaconitine, napelline, and lycoctonine. The first of these alkaloids is the most important, and possesses, among others, the following properties:—It becomes soft and pasty in boiling-water, and imparts to phosphoric acid, when evaporated along with that substance to a syrupy consistence on a water-bath, a violet colour, which remains even for days after the cooling of the mass. The aqueous solution of aconitine has a bitter taste, but not acrid; the solution is not precipitated by chloride of platinum, but the solution of the double salt of iodide of potassium and iodide of mercury produces, in such solutions, a copious non-crystalline precipitate. Aconitine is very soluble in ether, chloroform, and alcohol; it is anhydrous; its nitrate crystallises readily. Pseudaconitine does not become pasty in hot water, and does not exhibit the reaction with phosphoric acid above alluded to; it is very difficultly soluble in water, ether, alcohol, and chloroform; and crystallises better (in large prismatic-shaped crystals) than aconitine.

NOTES AND QUERIES.

Tabachere.—Can any of your readers give me information as to the chemical composition and properties of this substance. It is said to be produced from the bamboo.—WM. LANT CARPENTER.

Anthracene.—(Reply to "H. J.")—The large manufacturing firm of Messrs. Gehe and Co., at Dresden, forward us their price lists, published quarterly; in their list for September, the price of anthracene is quoted at 2 Rths. per pound, equal to about 6s. 6d. English currency.

Ethers in Wine.—Can any of the readers of "Notes and Queries" inform me where I shall find Berthelot's formula for calculating the amount of the compound ethers contained in wine, and also the method pursued for the estimation of those ethers?—H. T. B.

Hydrogen Apparatus.—T. A. White wants to know how to use a "hydrogen apparatus," said to be Woolfe's, having a cylinder for generating hydrogen, with a blowpipe attached to it underneath, in a drawer, in the front of which is a small spirit-lamp to ignite the hydrogen jet.

Black Japan.—(Reply to "S. R. H.")—We have not space to enter into particulars on this subject; you are referred to the "New York Coach-Makers' Monthly Magazine," and to Cooley's "Cyclopœdia of Practical Receipts," both of which works may be inspected at the Library of the Commissioners of Patents.

Estimating Cyanides.—(Reply to E. Outhet.)—Since cyanides are very readily decomposed by acids, and since the substances employed to make the brown sulphate of ammonia are saturated with acid previous to evaporation, it is hardly likely that any cyanide should be left undecomposed in the crude sulphate of ammonia; but, should there be any left, you will be enabled to estimate it by the methods fully described in the fifth edition of Dr. Fresenius's "Quantitative Chemical Analysis, edited by A. Vacher, page 170 and following.

TO CORRESPONDENTS.

E. Kernan.—There is an English edition published in America.

C. E. Craven.—(1) The work will not be ready for some time to come. (2) We do not know of such a work in English.

Querist.—Mr. Wanklyn is not a foreigner. On referring to Poggendorff's "Biographical Dictionary," we find that he was born at Ashton-under-Lyne, near Manchester. Last year he was elected a Corresponding Member of the Munich Academy of Sciences.

Vox.—(1) The Royal School of Mines is in Jermyn Street, W. (2) Dr. Yeats's book, reviewed in No. 568 of our journal, is the only work we know of treating on the subject.

B. W. Gibsons.—Received.

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Royal Polytechnic.—The Praeger Family give their Refined CONCERTS daily at half past 3 and 8.—Professor Pepper exhibits daily, at Quarter to 3 and quarter-past 7, the effects and describes the various modes of causing GHOSTS of human beings to appear and dis-appear, crawl, leap, and dance on walls, or float in space; also shows the latest novelty, viz., Grotesque Shadow Faces produced on the screen by *Walnut Kernels*.—Notes from a popular Opera by Suchet Champion.—The whole 1s.

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THE CHEMICAL NEWS.

VOL. XXII. No. 571.

ON THE SOLVENT POWER OF ANHYDROUS LIQUID AMMONIA.*

By Professor CHARLES A. SEELY, of New York.

PROFESSOR SEELY states that he has made the discovery that ammonia has a solvent power upon certain metals, and that he has actually succeeded in obtaining a solution of sodium in liquid ammonia. This solution presents all the physical characteristics of a true solution. On evaporation, the sodium is gradually restored to the metallic state in the same continuous manner in which the solution has been affected. The colour of the solution is a very intense blue, and its opacity or high tinctorial power is urged as an argument in favour of the notion that the metal is in simple solution. Weyl had made the capital discovery that when gaseous ammonia is condensed by pressure and cold on sodium, a blue liquid is the product, but he had mistaken the nature of this product. Professor Seely has experimented on various substances, and has concluded that ammonia is a solvent of metals; that other metals can be dissolved in ammonia, and the details of his experiments in confirmation of the views, will be the subject of another paper.

ON EDIBLE EARTH.†

By Prof. C. W. C. FUCHS.

To the list of the earth-eating people the Javanese must be reckoned; a fact brought to our knowledge by Alex. von Humboldt. From the specimens which I have had the opportunity of seeing, it is to be inferred that earths of very different external appearance and of different character are eaten. One deposit of such edible earth, possessing an intensely red colour, exists in the neighbourhood of Sura Baja, between strata referable to the time of the latest tertiary.

This earth is formed into thin cakes, having a diameter of from 1—1½ inches; it is then dried over an open fire, and in this condition is brought into the market. It is perfectly smooth to the touch, and is composed of materials in the finest state of subdivision. By a chemical analysis, to which I subjected it, after removing the thin stratum of soot, which settles upon it during the process of drying over the fire, I convinced myself that it does not contain the slightest trace of an organic substance. The analysis gave the following result:—

SiO_2	50·63
AlO_3	21·32
FeO_3	10·47
H_2O	12·97
CaO	2·40
MgO	0·33
K_2O	1·02
Na_2O	0·23
	99·37

Of the water, 6·36 per cent was driven off below red heat. The remaining 6·61 per cent disappeared only when the test portion was heated to bright redness. From the analysis it is apparent that the earth consists of a clay rich in iron, in which is still retained small quantities, yet undecomposed, of the minerals from which it derived its origin. In this way the trifling percentage of potassa and soda may be accounted for. Taking away the accessory alkalies, and so much of the silica as they demand, there remains behind a clay of the formula:—

$$H_2(Al,Fe)Si_2O_8+H_2O.$$

Humboldt suggested that the probable explanation of the earth-eating habit might be found in the desire to fill the stomach, and thus, in a measure, to allay the pangs of hunger. This view of the subject may be satisfactory when applied to those rude people who devour it in great quantity; but it will not apply to the case of the Javanese, who make this use of but trifling quantities. With these it is much more probable that the physical properties of the earth alone are sufficient to furnish the cause we are seeking.

Upon rubbing it, not the slightest grittiness is perceptible, and on being moistened with water it forms a smooth and unctuous mass. The enjoyment derived from eating it seems to reside in the similarity of the sensations it produces with those derived from the eating of fatty substances. In many parts of Würtemberg the quarrymen have the habit of eating the smooth, unctuous clay which collects in the fissures of the rocks. The term "Mondschmalz," which they apply to it, would seem to refer to the enjoyment they experience in the process of eating.

ON THE CALORIFIC POWER OF HARE'S BLOWPIPE.

By W. MARSHALL WATTS, D.Sc.

THE explanation of the formula for the calculation of the temperature of the oxy-hydrogen flame, asked for by Professor Wurtz, is easy. In the combination of 1 lb. hydrogen with 8 lbs. oxygen 34,462 units of heat are produced, that is, enough heat to raise 34,462 lbs. water from 0° C. to 1° C. This heat is expended first in raising the temperature of the water produced from 0° C. to 100° C., then in converting it into steam at 100° C., and finally in raising the temperature of the steam from 100° C. to the temperature of the flame. Calling this unknown temperature t we have the equation—

$$34462=9\{100+537+(t-100)0{\cdot}4805\}$$

$$\text{whence } t=\frac{34462-9(637-48{\cdot}05)}{4{\cdot}3245}$$

$$=6743^\circ$$

Or we may suppose the water produced first of all changed into steam at 0° C. in which case we must take the latent heat equal to 606·5, and in this case—

$$34462=9(606{\cdot}5+t\times0{\cdot}4805)$$

whence $t=6707^\circ$.

NOTES ON THE EXTINCTION AND REDUCING POWER OF MERCURY.*

By Dr. ISIDOR WALZ.

AT the last meeting of the chemical section of the Lyceum I drew attention to the conversion of liquid zinc-amalgam to a gray powder, when shaken with a solution of potassium bichromate. Subsequently I became convinced that this phenomenon was solely due to the extinction of the mercury, and have made a number of experiments regarding the phenomenon, of which I present the following results. It is hardly necessary to state that the mercury used was absolutely

* Abstract of a paper read before the American Association for the Advancement of Science, 1870.

† Communicated by Dr. W. H. Wahl. From advance-sheets of the *Journal of the Franklin Institute*.

* Read before the New York Lyceum of Natural History.

pure. It is very difficult, but essential, to use chemically pure mercury, as even a very small trace of a foreign metal is often sufficient to influence the results materially. The experiments were made in ordinary test-tubes, in which the materials were shaken a length of time varying from a few seconds to 10 minutes. I believe that we ought to distinguish between two methods or kinds of extinction, namely the mechanical and the chemical. The former is effected by a very large number of solutions of neutral salts, which exert no chemical action on mercury, and even by pure water, if shaken long enough. The extinction of the mercury in this case is produced simply by the interposition of fine films of the liquid between the globules, into which the mercury is separated by the mechanical agitation, and which are thus prevented from running together again. By mechanical extinction, mercury is converted into what appears to be a fine powder, which, however, never loses its white colour and metallic appearance, and under the lens its globular structure is clearly seen.

Quite interesting in many cases are the reactions which accompany the chemical extinction of mercury, which takes place when the metal is shaken with a solution of a salt, by which it is chemically affected. In these cases, the newly-formed mercury compounds act in the same way as the films of liquid in the former instance, preventing the separate globules from re-uniting. A finer division of the metal is obtained in less time than by the mechanical method, and the resulting metallic powder is generally of a dull gray leaden colour. When a solution of potassium bichromate is poured upon mercury, the convexity of the surface is at once destroyed; presently the surface is tarnished and begins to look wrinkled, while, at the same time, a greenish-black powder commences to deposit itself. This greenish-black powder is a mixture of chromic and mercurous oxide; it is formed abundantly when the two liquids are agitated more or less strongly; the mercury is at the same time completely extinguished, and at the end of the reaction neutral potassium chromate alone remains in solution, which is not acted upon by mercury. Ferric chloride extinguishes mercury; ferrous and mercurous chlorides are formed. Potassium permanganate also acts upon the metal; manganic and mercurous oxides are deposited, while potassic hydrate remains in solution. Mercury shaken with Fehling's solution is simply extinguished mechanically, when all the reagents used are pure; but when a very small quantity of zinc-amalgam is added, Cu_4O is reduced from the solution.

A solution of potassium ferricyanide does not affect the fluidity of mercury; but when the two are shaken together, a green powder is formed in large quantities, which, if allowed to stand, changes to a dark, and later still to a light, blue colour. Potassium ferrocyanide appears to be formed at the same time. I am still engaged in studying this interesting reaction, and will endeavour to determine if this blue powder is Prussian blue or not. Sodium hyposulphite, also, does not affect the mercury physically; on agitation, however, a heavy black powder, mercuric sulphide, is formed. Its amount increases with the lapse of time, and in one of my test-tubes, which has hardly been disturbed for weeks, the original black sulphide has assumed a yellowish red colour.

I conclude from these observations that the reducing power of pure mercury is greater than is generally supposed, and I expect to be enabled to obtain some interesting results from an extension of these experiments.

I have repeated some of Loew's experiments, which he described at our last meeting, and can state that similar results are obtained by substituting palladium bichloride for the platinum salt. I cannot, however, yet coincide with him in considering his final product as hydrogenium-amalgam, as by every method by which it has yet been made it contains another metal besides mercury and hydrogen, namely, either platinum, palladium, gold, or silver, in no inconsiderable proportion.

SPECTROSCOPIC NOTES.

By Prof. C. A. YOUNG, Ph.D., of Dartmouth College.

Spectrum of a Solar Spot, April 9, 1870, P.M.

EXAMINED the spectrum of a large group of spots a little north and east of the sun's centre.

The nucleus of the most southerly member of the group reversed the C line finely, turning it into a conspicuous bright line for about 20" of its length, without any distortion, however, such as is common upon this (dark) line in the neighbourhood of spots.

F was also reversed, but rather faintly.

D_3 could not be made out at all in the nucleus spectrum; neither were 2796 (the numbers refer to Kirchhoff's map) nor *h* reversed. I thought, however, that they were somewhat *thinned*.

The reversal of C and F continued through the whole afternoon.

On the other hand, many of the dark lines were widened and deepened in this nucleus spectrum in the manner which the description and figures of Mr. Lockyer have made familiar. Many also were unaffected. Among these were notably *a*, B, E, 1474, the four lines of *b*, 1691 and G.

The two sodium lines D_1 and D_2, and 850 (Fe) were distinctly, but not greatly, widened.

The effect was most marked upon the following:—864 (Ca), 877 (Fe ?), 885 (Ca), 895 (Ca and Li), 1580 (Ti), 1599 (Ti), 1627 (Ca), and 1629 (Ti). I have marked 877 doubtful, because there lies very near it a line whose origin is

unknown, and I am not sure to which of the two the thickening was due. The Titanium lines are identified as such by reference to Angström's atlas. I was greatly surprised at the prominence they assume in the spot-spectrum, as they are inconspicuous in the normal spectrum; and a similar remark applies to the calcium lines.

I do not intend to convey the idea that the lines mentioned were the only ones that were much deepened; there were many others, mostly faint, affected to nearly the same degree, but I had not time to identify them.

There was, at the same time, an exceedingly brilliant protuberance on the south-west limb of the sun (position angle 230°), near, but not over, a large spot which was just passing off. At the base of this prominence, which was shaped like a double ostrich plume, the C line was intensely brilliant, so that the slit could be opened to its whole width in studying the form above described, but it was not, so far as I could see, in the least distorted. On the other hand, the F line, also very brilliant, was shattered all to pieces, so that at its base it was three or four times as wide as ordinary, and several portions of it were entirely detached from the rest. The figure, without pretending to exact accuracy, and for the sake of distinctness a little exaggerated, gives a fair idea of the nature and extent of the "shattering" alluded to.

Since the C line was not similarly affected, it is hardly possible to attribute this breaking up of F to cyclonic motions in the gas from which the light emanates, and it becomes very difficult to imagine a cause which can thus disturb a single line of the spectrum by itself. Possibly this appearance may be the result of local absorptions acting upon a line greatly widened by increase of pressure or temperature.

It continued unchanged for more than half an hour, and until the sun passed out of sight behind a building. The observations were made with the 5-prism spectroscope.—*Journal of the Franklin Institute.*

NOTES OF CONTRIBUTIONS TO MINERALOGICAL CHEMISTRY.*

By Prof. A. H. CHURCH, M.A.

I AM anxious to draw the attention of the chemical section to the special features of certain mineralogical researches on which I have been engaged for the last six years. I have had three objects chiefly in view.

(1.) The elucidation of obscure minerals by exact and minute analysis.
(2.) The discovery of new species and varieties.
(3.) The chemical structure of minerals.

Besides the direct determination of every ingredient of a mineral, I have been led to consider the mode of desiccation of a mineral as of the very highest importance to the attainment of satisfactory results. When I commenced, in 1864, one series of experiments, "the revision of the mineral phosphates," I wrote, "If chemists had invariably analysed natural phosphates in the same manner as the preparations of the laboratory, the discrepancy in the above results could scarcely have occurred. Many other hydrous minerals are in the same predicament—the hygrometric condition at the time of analysis has not been determined." In numerous instances I have been able to throw much light upon the constitution of a mineral, and also to explain the most singular anomalies and divergences in earlier analyses by simply drying the specimen previous to analysis, first over oil of vitriol *in vacuo*, then at 100°, and then at gradually increasing temperatures. I have drawn up in a compact form, and in alphabetical order, a brief account of some of the chief minerals, new, rare, anomalous, or obscure, which I have lately analysed. Many of the results have been already published, but several new analyses are included. The several series which are still being continued are—

Revision of the mineral phosphates.
Chemical researches on new and rare Cornish minerals.
Mineralogical notices.

Atacamite.—New to Britain.
Bayldonite.—New to science.
Calaite.—Revision of formula.
Chalcophyllite.—Revision of formula.
Childrenite.—Revision of formula.
Chloropal.—New to Britain.
Churchite.—New to science.
Cornwallite.—Revision of formula.
Delvauxite.—Revision of formula.
Dufrenite.—Revision of formula.
Hisingerite.—New to Britain.
Limnite.—Analysis of a remarkably pure specimen.
Melanconite.—New form.
Namaqualite.—New to science.
Pagodite.—New analyses.
Restormelite.—New analyses.
Tallingite.—New to science.
Tasmanite.—New to science.
Tavistockite.—New to science.
Woodwardite.—New to science.

In addition to the minerals named above, experiments have been made upon several others, the results of the analyses having been published in some instances, in others being reserved till more conclusive. These minerals are :—

Autunite.
Brochantite.
Devilline.
Langite.
Ehlite.
Marmatite.
Phosphochalcite.
Prasine.
Torbernite.

Atacamite, $CuCl_2,3CuO,4H_2O$; or $CuCl_2,3CuH_2O_2$,aq.—This species is found in Wheal Cock, near Wheal Botallack, Cornwall. Until I identified specimens from that locality it does not appear to have been recognised as a British mineral. The experimental and theoretical percentages are here compared.

	Experiment.	Theory.
Cu	13·57	14·3
Cl	15·20	16·0
CuO	54·32	53·6
H_2O	16·91	16·2
	100·00	100·0

For details see *Journ. Chem. Soc.* (2), iii., pp. 81, 213; Dana's "Mineralogy," 5th ed., p. 121.

Bayldonite, $PbCu_2AsO_4,CuH_2O_2$,aq.—This lead and copper arseniate is a distinct species, first recognised in 1865. It is by no means a rare material, many specimens occurring in old collections of Cornish minerals under erroneous designations. It presents the appearance of minute mammillary concretions with a drusy surface: its density is 5·35, and its hardness 4·5; its analytical and theoretical percentages are as follows :—

	Experiment.	Theory.
PbO	30·13	30·7
CuO	30·88	32·8
As_2O_5	31·76	31·6
H_2O	4·58	4·9
Loss	2·65	—
	100·00	100·0

For further details see *Journ. Chem. Soc.* (2), iii., p. 265 Dana's "Mineralogy," 5th ed., p. 565.

Calaite, $AlPO_4,AlH_3O_3$,aq.—The true Persian turquoise has been analysed with rather perplexing results. But if the intruding copper, iron, and manganese phosphates be excluded, the composition of the true basis of the turquoise is arrived at. The direct analytical results establishing the true formula of this species are here given.

	Experiment.	Theory.
P_2O_5	32·86	32·6
Al_2O_3	40·19	46·9
CuO	5·27	—
FeO	2·21	—
MuO	0·36	—
H_2O	19·34	20·5
	100·23	100·0

For further details see CHEM. NEWS, vol. x., p. 290.

Chalcophyllite—
$Cu_2H_2AsO_4$,4aq.,$6CuH_2O_2,Al_2H_6O_6$,11aq.—Chalcophyllite, the tamarite of Brooke and Miller, has been often analysed with most contradictory results. By numerous trials I found that part of its water (11 aq. above) was held much less tenaciously than the rest, and that it invariably contained a definite amount of alumina. The foregoing revised formula represents the results of my analyses.

	Experiment.	Theory.
CuO	46·14	44·82
Al_2O_3	5·97	7·26
As_2O_5	15·54	16·21
H_2O	31·75	31·71

Further details in *Journ. Chem. Soc.* (2), viii., p. 168.

Childrenite.—As yet I am unable to speak with confidence as to the true constitution of childrenite: I have made many analyses of the mineral, but the samples picked for analysis, though selected fragment by fragment, under the microscope, contained, besides one per cent of

* Read before the British Association, Liverpool Meeting, Section B.

silica, evident traces of chalybite. I have, however, learnt that the only analysis of the mineral yet published is too low in the phosphorus pentoxide and too high in the ferrous oxide, that a part of the iron is in the ferric condition, and that the formula suggested by Rammelsberg will have to be modified.

Chloropal, $Fe_2O_33SiO_2,5H_2O$?—I first detected chloropal, in England, in 1865, in seams of granite in a quarry about three-quarters of a mile from the old tin mine of Carclaze, St. Austell; it has since been found in abundance in other parts of Cornwall. The state of oxidation of the iron varies; there is always some in the ferrous condition. The water is partly held in a state which the heat of the water-oven suffices to alter; the formula of this mineral thus dried is probably $Fe_2O_33SiO_2,3aq$. Some specimens contain a good deal of alumina (8·58 per cent in one instance) and traces of lime and magnesia. This mineral and some of its varieties is still under investigation, and, on this account I reserve further details of my analyses.

Churchite, $5CeO,CaO,2P_2O_5,8aq$.—The discovery of this species in 1864 was also the discovery of the occurrence of cerium in England. The mineral, which occurs in definite crystals of hardness 3, and density about 3·14, is also new to science. It is of Cornish origin, and occurs with quartz in a copper lode. The chief metallic constituent of the species, though put down as cerium, really contains lanthanum and didymium as well. The mean results of analysis are as follows:—

	Experiment.	Theory.
CeO	51·87	52·73
CaO	5·42	5·47
P_2O_5	28·48	27·73
H_2O	14·93	14·07
	100·70	100·00

For further details see Chem. News, vol. xii., pp. 121, 183 (1865); *Journ. Chem. Soc.* (2), iii., p. 259.

Cornwallite, $Cu_32AsO_4,2CuH_2O_2,aq$.—The hitherto accepted formula for this very rare cupric arseniate was founded upon two incomplete analyses. By numerous analyses of three good specimens I succeeded in proving that two-fifths of the water assumed in the formula was not really present. Since my new analyses were published I have confirmed the views there stated by fresh studies, both chemical and microscopical, of the mineral. For details see *Journ. Chem. Soc.* (2), vi., 276.

Delvauxite, $FePO_4,FeH_3O_3,aq$.—This formula represents the composition of delvauxite (from Liege) freed from hygroscopic water by desiccation over sulphuric acid *in vacuo*. Dried at 100° the mineral loses one atom of water, and has then the formula of dufrenite. The older analyses of delvauxite gave most discordant results as to its percentage of water.*

Dufrenite, $FePO_4,FeH_3O_3$.—Previous to some analyses of dufrenite which I made in 1864 the formula of dufrenite was unsettled, owing to the difficulty of obtaining samples for analysis free from the matrix of hæmatite, and to the obstinacy with which a portion of the constituent water is retained.†

Hisingerite, $Fe_2O_3,2SiO_2,2aq$; or $5Fe_2O_3,9SiO_2,8aq$.—This species was discovered for the first time in Cornwall last year. The analytical results of previous examinations of this substance have been rather variable, partly owing to the hygroscopic water present. *In vacuo*, over sulphuric acid, the powdered mineral lost in one instance 28·65 per cent of water, and at 100° only 0·54 per cent.‡

Limnite, $Fe_2O_3,3H_2O$; or $Fe_2H_6O_6$.—This species is the normal ferric hydrate, and very rarely occurs in a pure condition. A singularly clean specimen, of a stalactite form, from the Botallack Mine gave me the percentages which are compared below with those demanded by theory.

	Experiment.	Theory.
Fe_2O_3	73·73	74·8
H_2O	24·40	25·2
Loss	1·87	—
	100·00	100·0

For details see *Journ. Chem. Soc.* (2), iii., p. 214; Dana's "Mineralogy," 5th ed., p. 178.

Melanconite, CuO.—Some black crystals, of density 5·83, embedded in a greenish matrix were found in Cornwall; they were handed to me by Mr. Talling. They proved to be pure cupric oxide. Professor Maskelyne has determined them to belong to the oblique prismatic system.*

Namaqualite, $Al_2H_6O_6,4CuH_2O_2,4aq$. — This mineral from Namaqualand, South Africa, belongs to the rare class of hydrous oxides in which a protoxide and sesquioxide are united. It occurs in fine blue silky crystals.†

Pagodite.—Without attempting to assign a formula to the particular kind of Chinese "figure-stone," which seems to me to belong to the pagodite analysed by Walmstedt and Brush (Dana, p. 455), I may add the following analytical results to those already on record in the hope that the chemistry of the various minerals often included under agalmatolite may become ultimately more definite; a greenish grey Chinese figure-stone, of hardness 2·5 and density 2·8, gave, on analysis, the following mean percentages:—

Al_2O_3	31·06
SiO_2	62·25
H_2O	4·66
Fe_2O_3	0·82
MgO	0·60
	99·39

Restormelite.—Under the names of lithomarge, agalmatolite, or steatite, a massive greenish grey mineral, found in some abundance in the iron mine of Restormel, has been from time to time described. Its density is 2·58, its hardness 2. It differs from pinite by containing 12 instead of 6 per cent of water; it differs from halloysite by the presence of 7 per cent of alkalies. It seems to me to present evidence of being derived from a felspar; but, if so, the decomposition has not been complete. I hardly like to assign the rank of a species to restormelite, but, whatever the position ultimately assigned to it, a distinct name is necessary.‡

Tallingite, $CuCl_2,4CuH_2O_2,4aq$.—This mineral, which I first detected and analysed in 1865, is ranked by some mineralogists as a sub-species or as a variety of atacamite. Besides possessing a different composition, with a different colour and other physical characters, it appears to have that definiteness and constancy of composition without which a non-crystalline mineral is regarded with suspicion.

	Experiment.	Theory.
Cu	10·11	22·55
Cl	11·33	
CuO	53·57	53·29
H_2O	24·99	24·16
	100·00	100·00

Another blue hydrated cupric oxychloride from the same mine, Wheal Cock, near Botallack, Cornwall, was found to be still more basic than tallingite.‖

Tasmanite, $C_{40}H_{62}O_2S$.—A fossil resinoid substance, of brown-red colour, occurring to the extent of 30 to 40 per cent in a shale from the River Mersey, Tasmania. It is supposed to have been originally the spore-cases of some cryptogam; its hardness is about 2·0 and its density 1·18. The analytical percentages follow:—

* Chemical News, vol. x., p. 145.
† *Ibid.*, vol. x., p. 157.
‡ *Journ. Chem. Soc.*, Jan., 1870.

* *Vide* Chemical News, xi., p. 122.
† *Journ. Chem. Soc.*, January, 1870.
‡ *Ibid.*, June, 1870.
‖ *Ibid.* (2), iii., p. 213.

	Experiment.	Theory.
C	79·34	79·21
H	10·41	10·23
O	4·93	5·28
S	5·32	5·28
	100·00	100·00

For further details, *Phil. Mag.* (4), xxviii., p. 465.

Tavistockite, $Ca_3 2PO_4 Al_2 H_6 O_6$.—This mineral, occurring in minute white acicular crystals with quartz, pyrites, childrenite, &c., has been found near Tavistock, and at Stenna Gwyn. It might be mistaken for pharmacolite. It gave on analysis—

	Experiment.	Theory.
CaO	36·27	35·97
Al_2O_3	22·40	22·06
P_2O_5	30·36	30·41
H_2O	12·00	11·56
	101·03	100·00

For analyses see *Journ. Chem. Soc.* (2), iii., p. 263.

Woodwardite, $3CuSO_4, 8CuH_2O_2, 3Al_2H_6O_6, 6aq$.—This Cornish species is near Lettsomite (Cyanotrichite). It occurs in minute botryoidal concretions of a rich turquoise or greenish blue colour. In composition it is perfectly definite and constant, but Professor Maskelyne considers it to be allophane, which contains 20 per cent of silica, though the new mineral merely contains traces (about 1 per cent) of that substance. On the other hand, M. Pisani considers it impure langite, assigning as his reason for this view that another mineral occurring in the same mine, of a dirty green colour and obviously mixed character (some specimens being made up of nine* different layers), was of indefinite constitution. It is unnecessary to combat these views.

ON THE

ACTION OF SULPHURIC ACID ON DIALLYL.†

By WILLIAM ROBERT JEKYLL.
Dalton Chemical Scholar in Owen's College.

DIALLYL was first prepared by Berthelot and Luca in 1856, They found that it dissolves in concentrated sulphuric acid with the evolution of much heat, and that after some hours an oil separates, which appears to be modified hydrocarbon.

In 1866 Schorlemmer published a paper on a new series of hydrocarbons derived from coal tar, having the formula $(C_nH_{2n-2})2$ (*Proc. Roy. Soc.*, xv., 132). He there says, "As these hydrocarbons were obtained by the action of sulphuric acid on coal tar oils boiling below 120°, and as they differ by C_2H_4, it appears to me almost certain that they are polymers of the hydrocarbons of the acetylene series, C_nH_{2n-2}, formed in the same way as diamylene is formed by treating amylene with sulphuric acid. In order to test this theory I have made some experiments with the two isomers C_6H_{10}, viz., diallyl and hexoylene. By acting with sulphuric acid on these compounds, I obtained, besides large quantities of tarry matter, polymeric modifications boiling above 200°, having a smell similar to the hydrocarbons described above, giving also similar nitro-compounds; but the quantities which I got were not large enough for a more exact examination." With a view to throwing light upon this point, at the request of Mr. Schorlemmer I undertook to investigate the action of sulphuric acid on diallyl. The diallyl used was obtained by the action of sodium upon allyl iodide and boiled at 59°. Since concentrated sulphuric acid acts with great violence upon diallyl, the latter was diluted with about an equal bulk of pure paraffins boiling at from 55° to 60°. To this mixture sulphuric acid was gradually added in small quantities, the bottle being frequently shaken. At the end of the reaction the contents of the bottle were found to be arranged in two layers, of which the upper one consisted of unaltered paraffins, and the whole of the diallyl having been taken up by the acid. The heavier and acid portion was diluted with water, when a dark coloured oil lighter than water separated out, and the whole was distilled from a large flask. The distillate consisted of a light oil, which came over below 100°, mixed with a little water. After a second solution in sulphuric acid and a repetition of the foregoing processes, in order to remove all traces of the paraffins, the oil was dried over calcium chloride and heated for some hours over potassium. The oil was thus obtained pure and boiled constantly at 93°. Analysis showed that its composition is expressed by the formula $C_6H_{12}O$.

This substance is readily soluble in concentrated sulphuric and fuming hydriodic acids, and slightly so in water. It is unacted upon by either caustic potash or potassium, and possesses a strong ethereal odour like that of peppermint. In presence of potassium bichromate and sulphuric acid, it yields a blue colour, similar to that produced by perchromic acid and common ether.

This compound has already been obtained by Wurtz (*Ann. Chim. Phys.*, (4), iii., 174), by treating di-iodhydrate of diallyl with silver oxide. He calls it diallyl monohydrate, but says further on that this body comports itself as an oxide or anhydride (ether), corresponding to dihydrate of diallyl, $\left.\begin{matrix} C_6H_{12} \\ H_2 \end{matrix}\right\} O_2$, standing to the latter in the same relation as hexylene oxide to hexylene glycol, and might be called therfore *hexylene-pseudoxide*. As I have shown that the body is not acted upon by potassium, this view of Wurtz's is correct—it cannot be a hydrate, and I therefore propose to adopt Wurtz's second name, and to call it pseudoxide of hexylene.

To throw some light on its constitution it was oxidised by heating it in sealed tubes with a solution of potassium bichromate and sulphuric acid. On opening the tubes carbonic acid was evolved. Their contents were distilled, and the distillate neutralised with sodium carbonate, The neutral sodium salt was heated in a retort with sulphuric acid, by which means a distillate was obtained, which furnished a silver salt. The following analysis shows the salt to be silver acetate:—

Found.	Calculated for silver acetate.
64·41 per cent silver.	64·67 per cent silver.

The mother-liquor likewise furnished silver acetate.

Repeated experiments showed that nascent hydrogen evolved from sodium amalgam is without action upon hexylene pseudoxide.

Hydriodic acid acts upon the pseudoxide even in the cold. A few grammes of the substance were heated at 100° with an excess of fuming hydriodic acid in sealed tubes for about four hours. A red heavy liquid formed at the bottom of the tubes, the contents of which were distilled from a retort in presence of a little phosphorus. The iodide in the distillate was separated from the water, dried over calcium chloride, and distilled under a partial vacuum. On distillation, much decomposition ensued, with the formation of hydriodic acid, a little free iodine, and with the separation of tarry matter. After a second distillation *in vacuo*, and drying over caustic potash, a liquid was obtained, boiling under the ordinary pressure of the atmosphere, at 165° to 167°, which is the boiling-point of the β hexylic iodide of Wanklyn (*Chem. Soc. Journal*, 21).

Several iodine determinations, made by means of an alcoholic solution of nitrate of silver, further shows the substance to be hexyl iodide.

Found.		Calculated for $C_6H_{13}I$.
(1)	(2)	
59·43	59·68 per cent iodine.	59·90 per cent iodine.

In order to convert hexyl iodide derived from hexylene pseudoxide into hexyl hydride, Schorlemmer's method was

* *Journ. Chem. Soc.* (2), iv. p. 130.

† Read before the Literary and Philosophical Society of Manchester, October 18th, 1870.

employed. The oil obtained by this means contained but little olefines, and after purification boiled constantly at 68° to 69°. The following results of analysis show that it consisted of hexyl hydride.

	Found. (a)	Found. (b)	Calculated for C_6H_{14}.
C	83·49	83·35	83·72
H	16·30	16·42	16·28
	99·79	99·77	100·00

A portion of this hexyl iodide was oxided by heating it in a flask attached to an upward condenser with a solution of bichromate of potash and sulphuric acid. During the operation much carbonic acid was liberated. The condensed acid was rendered neutral by sodium carbonate. From the sodium salt thus formed the acid was fractionated from a retort by adding successively five drops of sulphuric acid. From the first four distillates silver salts were obtained which furnished the following results on analysis.

	Found.	Calculated for silver acetate.
(1)	59·36 per cent silver.	64·67 per cent silver.
(2)	66·63 " "	" " "
(3)	64·13 " "	" " "
(4)	64·66 " "	" " "

The non-agreement of No. 1 with the calculated results was owing to the fact that the salt was very impure and uncrystalline, nor could I succeed in purifying it by re-crystallisation. From distillates No. 2 and 4 similar results were obtained from salts, which crystallised from the mother-liquors. A second series of experiments, in which a weaker oxidising solution was employed, also yielded carbonic and acetic acids as the products of oxidation. It is of interest that the hexyl iodide, which was obtained from hexylene pseudoxide, and the boiling-point of which resembled that of Wanklyn's β hexylic iodide, yielded carbonic and acetic acids as oxidation products, while the β iodide yields, on the other hand, butyric acid in addition.

The diluted sulphuric acid, which had been used for acting upon diallyl, was neutralised with barium carbonate, filtered and evaporated to dryness, but no organic sulpho-acid had been formed.

Polymers of Diallyl.—After distilling off the hexylene pseudoxide from the diluted acid, a layer of hydrocarbons remained on the top of the liquid, from which they were separated by means of a stop-funnel. The hydrocarbons were dried over calcium chloride, and found to boil at between 200° and 300°. After several distillations over metallic sodium, they were separated into three portions, boiling at from 205°—215°, 240°—245°, 275°—285°. These hydrocarbons invariably left a slight residue on distillation. Analysis showed that they have an empirical formula of C_6H_{10}.

(1) Boiling-point 205°—215°.

	Found. (a)	Found. (b)	Calculated for C_6H_{10}.
C	87·31	87·38	87·8
H	12·52	12·31	12·2
	99·83	99·69	100·0

(2) Boiling-point 240°—245°.

	Found. (a)	Found. (b)	Calculated for C_6H_{10}.
C	87·30	87·30	87·8
H	12·42	12·31	12·2
	99·72	99·61	100·0

(3) Boiling-point 275°—285°.

	Found.	Calculated for C_6H_{10}.
C	86·96	87·8
H	12·81	12·2
	99·77	100·0

No. 3 attacked sodium slightly, although it had been distilled over it several times, therefore it is probable that its non-agreement with the calculated result was owing to admixture with an oxygen compound. From the above analysis and boiling points, it is probable that at least two polymers of diallyl are formed by the action of sulphuric acid upon it. I had not, however, a sufficient quantity of the hydrocarbons to obtain satisfactory vapour density determinations, which would at once have settled the point. It is nevertheless probable that No. 1 consists of two molecules of diallyl condensed into one, and that it has the formula $C_{12}H_{20}$; for Schorlemmer, by the action of sulphuric acid on hydrocarbons boiling below 120° from cannel oil, obtained one which boiled at 210°, and the vapour density of which showed that its formula was $C_{12}H_{20}$.

In conclusion, I have much pleasure in tendering my thanks to Dr. Roscoe and Mr. Schorlemmer, for their kindness and attention to me throughout the whole course of this research.

ON A

SPECTROSCOPE IN WHICH THE PRISMS ARE AUTOMATICALLY ADJUSTED FOR THE MINIMUM ANGLE OF DEVIATION FOR THE PARTICULAR RAY UNDER EXAMINATION.

By JOHN BROWNING, F.R.A.S.

In spectroscopes of ordinary construction, when several prisms are employed, a great deficiency of light will be noticed towards the more refrangible end of the spectrum.

This arises from the fact that the prisms are adjusted to the minimum angle of deviation for the most luminous rays which occupy the middle of the spectrum. The effect of this is shown in Fig. 1, P P.

In Fig. 1, P P, &c., represent a train of prisms adjusted, as I have just described, for the central portion of the spectrum, and screwed firmly in their places. T represents a telescope, moving round a centre situated at K. In the position in which the telescope is placed, the whole field of the object-glass would be filled with the green light of the spectrum issuing from the last prism; but, when the telescope is removed to the position shown by the dotted lines, either nearer to R or to V (in which case the red end or the violet end of the spectrum would be in the field of view), then, as we see by the lines, only a small portion of the spectrum would fall on the object-glass. But, it is obvious that, owing to the deficiency in light at the extreme ends of the spectrum, it is just in these very positions that it is desirable that the whole field of the object-glass should be filled. Now this can only be effected when the prisms are adjusted to the minimum angle of deviation for the particular portion which is being examined of the spectrum, and this it will be if the adjustment I have spoken of has been correctly made. This difference of adjustment is much more than is generally supposed, varying, in accordance with the refractive index of the glass employed, between 10° and 20° for the extreme portions of the spectrum.

Fig. 2 shows the method in which the change in the adjustment of the prisms to the minimum angle of deviation for each particular ray is made automatically.

In this diagram, P P, &c., as before, represent prisms.

All these prisms, with the exception of the first, are unattached to the plate on which they stand, the triangular stand on which the prisms are hinged together at the angles corresponding to those at the bases of the prisms.

To each of these bases is attached a bar, B, perpendicular to the base of the prisms. As all these bars are slotted and run on a common centre, the prisms are

brought into a circle. This central pivot is attached to a dovetail piece of two or three inches in length, placed on the under-side of the main plate of the spectroscope; which is slotted to allow it to pass through. On moving the central pivot, the whole of the prisms are moved, each to a different amount in proportion to its distance in the train from the first or fixed prism on which the light from the slit falls after passing through the collimator, C. Thus, supposing the first prism of the train opposite C, represented in the diagram, to be stationary, and the second prism to have been moved through 1° by this arrangement, then the third prism will have moved through 2°, the fourth through 3°, the fifth through 4°, and the sixth through 5°. As these bars are at right angles to the bases of the prisms, and all of them pass through a itself, and thereby the whole field of the object-glass is filled with light.

Thus the apparatus is so arranged that on turning the micrometer-screw, so as to make a line in the spectrum coincide with the cross wires in the eye-piece of the telescope, the lever, L, attached to the telescope and prisms, sets the whole of the prisms in motion, and adjusts them to the minimum angle of deviation for that portion of the spectrum.

Figs. 3 and 4 represent the appearances presented when looking through the telescope from which the glasses have been removed; in diagram 3 it will be seen that the whole circle of the object-glass is filled with light, as I have just described is the case with the new arrangement; while diagram 4 shows the effect of moving

FIG. 1.

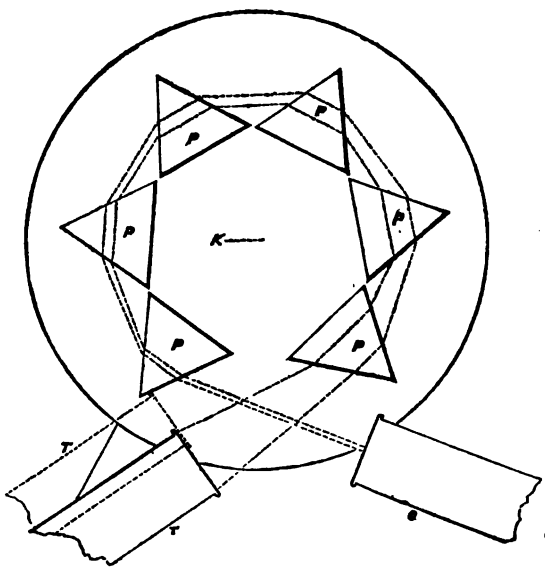

FIG. 2.

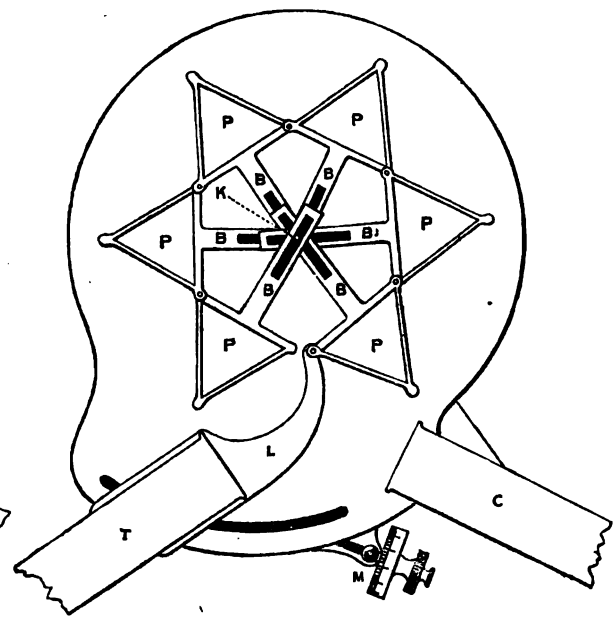

FIG. 3

FIG. 4.

common centre, it is evident that the bases of the prisms are at all times tangents to a common circle.

Now for the contrivance by which this arrangement is made automatic. A lever, L, is attached to the corner of the triangular plate of the last prism. This lever by its further end is attached to the support which carries the telescope through which the spectrum is observed.

Both the telescope and lever are driven by the micrometer screw, M. The action of the lever is so adjusted that when the telescope is moved through any angle it causes the last prism to turn through double that angle.

The rays which issue from the centre of the last prism are thus made to fall perpendicularly upon the centre of the object-glass of the telescope, T, and thus the ray of light travels parallel to the basis of the several prisms, and ultimately along the optical axis of the telescope the telescope through the angle in front of the fixed prism.

About three years ago I showed a rough model of the plan I have now described to Mr. Gassiot, for whom I made the large spectroscope which was for some time in use at Kew Observatory.

Mr. Gassiot immediately asked me if I would apply this arrangement to his large spectroscope. As I did not at that time see my way to make it self-acting by connecting the prisms with the micrometer-screw, I did not feel impelled to carry out the matter at once, owing to the fact that, about this time, the mapping of the solar spectrum, with the large spectroscope in question, was discontinued. I also felt that, with the munificent liberality for which Mr. Gassiot has distinguished himself, he had simply asked me to add this contrivance to his large and costly

instrument in the interest of science generally, and not with any view to its immediate use.

Since this time, and particularly while I was constructing his solar spectroscope, Mr. Norman Lockyer has repeatedly urged upon me the desirability of completing the arrangement, and from the manner in which it has been received by the distinguished scientific men who have done me the honour to examine it minutely, I am induced to hope that its application will tend to facilitate further researches in spectrum analysis.

The instrument I have had the honour to describe possesses some special advantages for chemical investigations. Professor Roscoe no sooner saw it than he suggested that I should observe the ultra-violet rays of aluminium with it. These it showed to great perfection.

It may well be that careful researches made by its aid on spectra of various bodies might lead to the detection of elements as yet unknown.

SODIUM AS A FLUX FOR MINERALS.

By Dr. SCHONN.

A STEEL crucible 1½ inches deep and the same in diameter is heated over a lamp; into this is projected a few pieces of metallic sodium, and afterwards the finely-divided and dry mineral is added. The crucible is then covered and heated red-hot. As soon as the reaction is finished the contents of the crucible are allowed to cool, and water is cautiously added, sufficient for the purpose of filtration. The fused mass is then thrown upon a filter and thoroughly washed. In the filtrate will be found the electro-negative constituents of the mineral combined with the sodium, such as sulphur, cyanogen, chlorine, chromic acid, silica, molybdic and tungstic acids, and such oxides as are soluble in soda-lye. On the filter will be found the metals and their oxides, also the lower oxides of titanium, molybdenum, tungsten, and possibly silica and alumina. The contents of the filter and the solution in the filtrate can be further treated according to the order of analysis. In this way all minerals can be readily resolved, and their constituents determined either qualitatively or quantitatively.

CORRESPONDENCE.

NEW ELECTRO-DYNAMIC LAW.

To the Editor of the Chemical News.

SIR,—Will you allow me to announce in your journal a new and important electro-dynamic law or laws. The reasonings and experiments, by which they are supported, I hope to enter on more fully in the next number of the *Quarterly Journal of Science*. Meanwhile, I submit them to the judgment of physicists for examination and approval, or otherwise.

1. In every galvanic circuit, the net heat produced by the chemical decomposition is divided into three parts—(*a*) due to merely local action arising from the impurities in the positive metal, or the re-formation of water from the nascent hydrogen; or (*b*) that which circulates through the battery and all other parts of the circuit, and which varies as the electro-motive power of the negative element in relation to the electro-positive; and (*c*) the residue which remains in the battery.

2. That part which circulates through the whole circuit is distributed in each part of the circuit, including the battery, in simple proportion to the resistance of each part.

These laws are thus expressed mathematically:—

Let H = total net heat produced;

H_1 = heat produced by waste local action on the positive metal;

H_2 = the quantity put into circulation;

H_3 = the residue not put into circulation.

Then, of course—

$$H = H_1 + H_2 + H_3;$$

$$\text{and } \frac{H_2}{H_2 + H_3} = E,$$

E being the electro-motive force of the negative element in relation to the positive element used.

Also, if H(*b*) be the total heat evolved in the battery when the circuit is closed;

$$h(b) = H_{(1)} + H_{(3)} + H_{(2)}\frac{R}{R + r}$$

$$h(w) = H_2\frac{r}{R + r}$$

and if $r_{(1)}$, $r_{(2)}$, $r_{(3)}$, be the resistance of different parts of the circuit;

and $h_{(1)}$, $h_{(2)}$, $h_{(3)}$, the heat evolved in those parts;

$$h_{(1)} = H_2\frac{(r_1)}{R + r}$$

$$h_{(2)} = H_2\frac{r_2}{R + r}$$

and so on.

$$\text{Again, if } H_{(3)} = 0 \text{ or } \frac{H_2}{H_{(2)} + H_{(3)}} = 1$$

then the electro-motive power of the negative element is perfect as relates to the electro-positive element.

In a circuit of zinc in sulphate of zinc, and copper in sulphate of copper, E = 1, or the whole heat produced, is transmitted; with zinc, strong sulphuric acid, and platinum, E = about ⅞, but varies with the strength of the acid; with iron in sulphate of iron, and copper in sulphate of copper, E = about ⅞; with copper in nitrate of copper, and silver in nitrate of silver, E = about ⅞.

The total electro-motive force of a couple depends partly on the net heat evolved, partly on the proportion of it transmitted through the circuit. The former depends principally on the positive element, the latter on the negative element.—I am, &c.,

H. HIGHTON, M.A.

2, The Cedars, Putney,
November 1, 1870.

MR. CHURCH'S PROCESS OF PRESERVING STONE.

To the Editor of the Chemical News.

SIR,—In your journal of last week I find the text of a paper, by Mr. A. H. Church, which was read at the Liverpool meeting of the British Association. Mention is made therein of a complex system of treating stone, which has been patented as a new invention, and recently applied upon certain portions of the Houses of Parliament. The method consists in washing the stone surfaces with three solutions successively applied: (1st) superphosphate of lime, now called "mono-calcic phosphate;" (2nd) baryta, or "barium hydrate;" (3rd) dialysed solution of silica.

It is my purpose now to show that this so-called new process is but a modification of that applied by myself on the Houses of Parliament in April, 1864, with points added, which may have been derived from other previously published sources. The *diglysed silica solution* is that of which the preparation and specific employment for these purposes was first described by yourself in November, 1861. (CHEMICAL NEWS, vol. iv., p. 227.) And, the *superphosphate of lime*, mixed with a little *baryta* for the purpose of decomposing the sulphates in the stone, was the solution actually employed by myself in the competitive trial at Westminster. Your readers are, therefore,

in a position to judge for themselves of the novelty of Mr. Church's improved process, which, by some unaccountable aberration, stands now patented in the name of Frederick Ransome.

I have only to add that I felt it my duty to address a letter upon the subject to the First Commissioner of Her Majesty's Works, protesting against this practical adoption of my process by a fellow competitor, immediately it became known to me that a trial of Mr. Church's triple plan had been sanctioned.—I am, &c.,

JOHN SPILLER.

London, Nov. 1st, 1870.

MISCELLANEOUS.

Spectrum of the Aurora.—We hear from Professor A. H. Church, of the Royal Agricultural College, that he was able to observe the spectrum of the aurora as seen at Cirencester on the 24th and 25th ult. He saw a steady yellowish green line, and frequently a brilliant red line near that of calcium. A pale line was also seen in the green, and a more definite one in the blue—these last not being constant in occurrence. The observations were made each evening between 6.30 and 8.30 p.m.

Apparatus for Maintaining Constant Temperatures in Laboratory Operations.—Messrs. Mottershead and Co. have just brought out an improved automatic regulator which is applicable to any operation in which gas is used as a source of heat. When fitted to copper drying closets or air baths the temperature may be limited to any degree from 75 F. upwards. This apparatus acting automatically, the temperature is unaffected by varying pressure of gas, the common source of accident in ordinary drying closets. Drying closets and evaporating basins are also fitted on a slightly modified plan, in which a reservoir of air placed *inside* the oven is made to act on the regulator, thus avoiding the necessity of a double copper chamber, and at the same time forming a sufficiently sensitive apparatus for many practical purposes.

The Photographic Exhibition.—The members of the Photographic Society will assemble at the Architectural Gallery, No. 9, Conduit Street, on Tuesday evening next, for the purpose of inaugurating their new session by the holding of the Fifteenth Annual Exhibition of Photographs. On the following day the galleries will be thrown open to the public, and continue so daily from 9 a.m. till dusk (Saturdays excepted) until the end of the month. The members have reserved to themselves and friends the right of free admission during the three Saturdays falling within this period, but the general public will, even on these days, be admitted on the usual terms of payment. In addition to the more ordinary productions of photography there will be exhibited examples of work done by the photo-mechanical printing processes of Herr Albert, MM. Ohm and Grossman, Mr. Woodbury, and others; besides a collection of photo-enamels, micro-photographs, reproductions, and enlargements.

Alloy known as "Tiers Argent."—Dr. C. Winkler.—The author says this alloy does not consist of ⅓ of silver and ⅔ of nickel, but was found, when analysed by him, to be made up of copper 59·06; silver, 27·56; zinc, 9·57; nickel, 3·42; total, 99·61.

Condensation of the Nitrous Vapours in the Manufacture of Sulphuric Acid.—R. Heilmann and P. Hart.—The vapours are condensed by means of water, wherein lime or magnesia are suspended, and the liquid thus obtained is either (*a*) first evaporated to dryness, and the residue ignited; or (*b*) heated to the boiling point, with addition of hydrochloric or sulphuric acid; or (*c*) evaporated to dryness, and the residue mixed with the residues of the manufacture of chlorine, and heated to a gentle red heat; in either of these three cases the nitrous vapours are again utilised in the leaden chambers.

Indelible Black Ink.—H. Puscher.—Dissolve 1 drachm of aniline black in 5 drachms of strong alcohol, to which add some 60 drops of pure and strong hydrochloric acid; next add a hot solution of 1½ drachms of powdered gum arabic in 3 fluid ounces of water. Writing made with this ink is indelible by chlorine, oxalic, nitric and hydrochloric acids, and caustic potassa.

Prevention of the Spontaneous Combustion of Coals.—Dr. A. Lachmann.—In order to prevent as much as possible the chances of spontaneous combustion of coal on board ships and in the coalbunkers of steam-vessels, the author advises: to select coal as much as possible free from brasses (iron pyrites); to load the coal rapidly, and in as dry a state as possible; to stow them on board properly, but not too closely; to prevent, as much as possible, all access of air and water, and to sprinkle them with thin coal tar.

Induline, a new Blue Dye Material.—R. Knosp.—The author states, unfortunately, nothing about the nature, nor anything about the manufacture, of what he calls induline. He says it is a new pigment which is readily soluble in water yielding therewith a reddish blue coloured solution, which can be at once applied for dyeing purposes; best, however, after the addition of some sulphuric acid, and at boiling heat. The author further states that induline will certainly become an excellent substitute for indigo vats, and be especially of value for the dyeing of wool.

Manufacture of Iodine from the so-called Chili Saltpetre (Nitrate of Soda).—Dr. A. Lachmann.—The author states that at Tarapaca, Peru, there are now obtained about 40 kilos. of iodine daily by means of a process which is described as follows:—The mother-liquors from the refining of the crude nitrate of soda are carefully mixed with a mixture of sulphurous acid and bisulphite of soda, whereby all the iodine present in the liquor is precipitated in the free state as a blackish coloured precipitate; the iodine thus deposited is next freed from adhering fluid by placing it in an earthenware vessel, at the bottom of which are placed several layers of clean sand, so arranged that the size of its grains decrease from the bottom upwards. On the top of this sand the wet iodine is put, the sand acting as a sponge to absorb the fluid. When the iodine has become dry, it is carefully removed from the vessel, but a thin layer of it is left on the sand; the crude iodine is refined by sublimation. The inventor of this process, a Frenchman named Thiercelin, has recently found that, instead of using sulphurous acid, it is more advantageous to employ nitrous acid, obtained in the shape of nitrite of potassa by the ignition of a mixture of 1 part of charcoal and 5 of nitrate of potassa; the nitrite obtained yields, when mixed with the mother-liquor, a precipitate containing some 80 per cent of iodine.

Fusing Iridosmine.—Mr. Moses G. Farmer, of Boston, has fused the native iridosmine by placing the natural grains in a groove in charcoal, and subjecting them to the action of a current of voltaic electricity from sixty large Bunsen cells, using large platinum wires to make contact with the ends of the groove. He obtained in this manner bars of perfectly compact metal, brittle and very hard. The operation was anything but pleasant, on account of the intense light emitted and the fumes of osmic acid, which attacked the eyes and nostrils, producing the phenomena of rose or hay fever, and sunburning the face. Mr. Farmer estimates the temperature of the fusion at about 10,000° F. The object of the experiment was to prepare a bar of the alloy for the purpose of electric illumination. On rendering it luminous by an electric current, he found that when near the melting-point one square inch of surface evolved light equal to 2800 candles, which threw shadows in broad daylight at noon, and produced excellent photographs. The same battery converted solid bichloride of iridium into fused metal as soft and ductile as platinum. An aluminium wire, conveying a current

which raised it to near its fusing point, became perfectly flexible, like a hempen cord, being fused within, but preserving its continuity by its crust of oxide. A steel point thrust into it drew out the fused metal in threads.—*American Chemist.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Zeitschrift für Chemie von Beilstein, No. 15, 1870.

The original papers and memoirs contained in this number are—

Products of the Oxidation of Durol.—P. Jannasch.—This paper is the first part of a series on this subject, the portion before us treating on cumylic acid. When durol is acted upon by nitric acid diluted with 2½ times its bulk of water, the result is the production of a third homologue of benzoic acid, an acid composed of—

$$C_{10}H_{12}O_2[C_6H_3(CH_3)_2.COOH],$$

which has been named by this author *cumylic acid*. It is insoluble in water, but readily soluble in ether and alcohol; soluble also, but with more difficulty, in benzol; crystallises in prismatic crystals; volatilises along with aqueous vapours; sublimable; fusing at 150°. The author briefly describes the lime- and baryta-salts of this monobasic acid.

Bromo-Sulpho-Toluol.—H. Hübner and F. C. G. Müller.—This lengthy paper contains the description of a series of salts obtained by operating with a large quantity of crude bromo-toluol-sulphate of calcium, after having been purified. The formula of this salt was ascertained, by analysis, to be $(C_6H_2Br.CH_3.SO_3.O)_2Ca$. It is an anhydrous salt, which admits of being heated to 230° without decomposition; it is soluble in 60 parts of water at 14°. From a concentrated solution the salt crystallises in large brilliantly-shining crystals. The lead, barium, strontium, copper, zinc, manganese, and sodium salts, obtained by double decomposition, are described at great length. The bromotoluol-sulpho acid, in free state, is a deliquescent substance. The sulphochloride, prepared from the above-named sodium-salt by means of chloride of phosphorus, constitutes a solid compound, fusing at between 25° to 53°, insoluble in water, very soluble in ether, and remarkably resisting decomposition. In perfectly pure state, it is possible to heat this substance to 200° without decomposition; but, at a higher temperature, sulphurous acid is given off, and at 260° the decomposition becomes tumultuous. The authors also prepared the sulphhydrate and the bisulphide of bromo-sulpho-toluol. The bisulphide is insoluble in water, fuses at between 75° and 78°, and is difficultly soluble in alcohol.

Presence of Cholesterine in Suint.—E. Schulze.—By the term suint is understood that peculiar kind of grease which is naturally present in sheep's wool. This raw material the author extracted from raw wool taken from sheep at a farmyard near Weende, a locality in the neighbourhood of Göttingen, Prussia, Regierungsbezirk, Hanover, where is established an agricultural experimental station, to which is attached a chemical laboratory. The author operated upon 120 grms. of the raw suint, which was saponified, by which operation it was ascertained, as has also been stated by Dr. Hartmann, that suint does not contain any glycerides. A large portion of the suint (70 per cent) could not be saponified by the usual process (boiling with an aqueous solution of caustic potassa), and was therefore exhausted from the soap by means of ether. After volatilisation of that fluid, the remaining fatty substance was treated, for a period of twenty hours, with an alcoholic solution of potassa in a closed vessel at 100°. After a series of operations (the aim thereof being to purify the complex fatty compound), the author obtained a crystalline mass, which was recognised as cholesterine by the following reactions:—A small portion, having been rubbed up in a mortar with a few drops of concentrated sulphuric acid, yielded, after addition thereto of chloroform, a blood-red coloured liquid, which, after the addition of concentrated nitric acid, became first violet, next blue, and finally colourless. A small portion of the crystals was mixed, by the aid of a glass rod, with a liquid consisting of 3 parts, by bulk, of hydrochloric acid, and 1 part, by bulk, of solution of chloride of iron, and this mixture very gently evaporated to dryness; the undissolved mass assumed a violet-red hue, which soon turns to blue. A trace of the crystals was moistened with a drop of concentrated nitric acid, and gently evaporated to dryness; the remaining yellow speck, having been moistened with ammonia, assumed a red colouration. The anhydrous crystalline mass was found to fuse at 144·5° (dry and pure cholesterine fuses, according to MM. Strecker and Hoppe-Seyler, at 145°). The results of the elementary organic analysis of this substance led to numbers which agree closely with those of pure cholesterine, the formula of which is $(C_{26}H_{44}O)$. The author states that the cholesterine in suint is mixed with substances on which he is engaged in further researches.

Chlorides of Sulphur.—H. Hübner and A. Gueront.—The authors first briefly allude to the well-known compound S_2Cl_2 which boils at 136·5°, and consists of 47·41 per cent S and 52·6 per cent Cl. This chloride is capable of absorbing more chlorine, and forms a new compound, about which various views have been stated by several distinguished scientific chemists, in reference to its true constitution. The authors have therefore made the following experiments, with the view to reconciling the existing differences of opinion:—About 80 grms. of perfectly pure S_2Cl_2 were placed in a glass vessel, surrounded by a powerful freezing mixture, and saturated with perfectly dry chlorine; the excess of the latter was driven off by perfectly dry carbonic acid, previously saturated with the chloride of sulphur, (S_2Cl_2). The newly-formed chloride, while remaining in the vessel surrounded by the freezing mixture, was sucked up in a previously accurately-weighed glass tube, which was sealed immediately afterwards, and again weighed. This having been done, the tube was carefully unsealed, and the contents immediately oxidised by means of pure and very strong nitric acid. The quantitative estimation of the chlorine and sulphur led to the following percentical results:—Sulphur, 31·07; chlorine, 68·93. The results of the researches on this subject may be summarised as follows:—There exist two definite compounds of chlorine and sulphur. One of these is a non-volatile chloride, Cl_2S, which, on being boiled, becomes decomposed in this manner:—$2Cl_2S=S_2Cl_2+Cl$. The equivalent of Cl_2S is, the authors state, not determinable, on account of the non-volatility of this body; but they take that equivalent as equal to 103. The second chloride of sulphur, S_2Cl_2, is readily formed from the other compound just alluded to, as elucidated by the formula above mentioned. The authors add that the results of their researches agree with and confirm those of M. Dumas on this subject.

Conversion of Allyl-Alcohol into Normal Propylic Alcohol.—B. Tollens.—This very closely-written paper contains chiefly the record of the fact, discovered recently by the author, that, when allyl-alcohol is treated with hydrate of potassa, there is obtained a considerable quantity of normal propylic alcohol, not mixed with isopropylic alcohol, when equal parts, by weight, of the two substances (viz., caustic potassa and allyl-alcohol) are operated upon. The author enters at length into the detailed description of a series of fractional distillation experiments and the substances thereby obtained, and concludes his memoir with the statement that his researches on this subject confirm the correctness of the following formulæ:—

Acroleine.	Allyl-alcohol.	Propylic alcohol.
CH_2	CH_2	CH_2
‖	‖	‖
CH	CH	CH_2
|	|	|
COH	CH_2OH	CH_2OH

Strychnine Oxethyl Compounds.—Drs. Strecker and Messel.—By heating, in a sealed tube, a mixture of one-fourth part, by weight, of epichlorhydrine, with strychnine, to a temperature of from 120° to 160°, the authors obtained strychnin-oxethyl-chloride, $C_{23}H_{27}N_2O_2Cl$, a body readily soluble in water, and crystallising from its solution in that liquid. The aqueous solution is not precipitated by ammonia; by a mixture of sulphuric acid and bichromate of potassa, the aqueous solution is temporarily coloured brilliantly violet. Chloride of platinum causes the precipitation of a magnificent orange-coloured double salt, $C_{23}H_{27}N_2O_2Cl+PtCl_4$. The authors briefly describe, further, a strychnin-oxethyl-sulphate and a strychnin-oxethyl-hydrate, and state that strychnine behaves in a manner analogous to trimethylamine, while they conclude that the constitution of this new base is analogous to choline, and should be formulated thus:—

$$\begin{array}{l} CH_2OH \\ | \\ CH_2.N(C_{21}H_{22}NO_2)Cl. \end{array}$$

Sulpho-Maleinic Acid.—Drs. Strecker and Messel.—Maleinic acid, having been boiled with an aqueous solution of neutral sulphate of potassa, yields a new body, sulpho-maleinic acid, which, however, is only cursorily alluded to in this paper as to its properties in free state, there being only mentioned a series of salts, the neutral potassa salt being represented by $C_4H_2K_2SO_7+H_2O$. The free acid was obtained by the decomposition of the silver-salt by means of sulphuretted hydrogen; it is a difficultly crystallisable solid body, which, on being heated with caustic potassa, yielded fumaric acid. The main conclusion the authors draw from their researches is the absolute identity of sulpho-fumaric, sulpho-maleinic, and sulpho-succinic acids.

Action of Ammonia upon Chloride of Thionyl and Chloride of Selenium.—Dr. A. Michaelis.—This very lengthy essay contains the exhaustive account of a series of researches instituted by the author with the view to test the correctness of the labours instituted on this subject by Dr. Schiff (*Ann. Ch. Pharm.*, vol. cii., p. 113, and vol. cxi., 93). The first portion of this paper treats on the action of ammonia upon thionyl-chloride; and the memoir, too lengthy for any useful abstraction, contains, further, the following sections:—Action of ammonia on selenyl-chloride; action of chloride of phosphorus upon selenious anhydride and upon selenyl-chloride.

Lime and Mortar.—W. Wolters.—The author has experimented to obtain accurate information on the process of the hardening of lime and mortar, as applied for ordinary building purposes. The main results of these researches are the following:—The freshly applied mortar gives off, at first, water only, by which process the particles of lime begin to adhere together; afterwards, carbonic acid begins to be absorbed, and thereby the solidity of the mass is increased. The last stage of the drying of the mortar coincides with that of the saturation of the lime with carbonic acid; and this process causes the fixation of

the porous bricks with the mortar. The absorption of carbonic acid alone, without previous dehydration, never causes ordinary mortar to become hard. Freshly made mortar, exposed to an atmosphere of moist carbonic acid, remains soft; while mortar placed under a bell-jar filled with carbonic acid, and standing over a basin filled with strong sulphuric acid, becomes rapidly hard. Large quantities of mortar, especially with a limited exposure to air, take months, or even years, to become hard.

Estimation of Phosphoric Acid in Phosphorites.—K. Birnbaum and C. Chojnacki.—The authors state that they apply, for the above-named purpose, a modification of Dr. G. Chancel's method, which admits of being carried out in about six hours, and gives good results. The analysis is performed as follows:—Take 2 grms. of the very finely pulverised mineral; put the weighed mineral into a flask, or beaker-glass, and pour over it about 7 c.c. of nitric acid free from any chlorine, and of 1·25 sp. gr. Heat the vessel and its contents for about half an hour nearly to the boiling-point, dilute with pure distilled water, and filter; add, to the well-washed filtrate, as much water as will suffice to make up a quantity of 500 c.c. Take 100 c.c. of this liquid, representing 0·4 grm. of phosphorite; add another 100 c.c. of pure distilled water, heat to the boiling-point, and precipitate the hot fluid by the addition of a solution of nitrate of bismuth (prepared in the following manner:—Take crystallised nitrate of bismuth, dissolve in water; add as much nitric acid as is required to prevent precipitation on the addition of more water; make up the solution in such a manner as to obtain a litre of fluid containing 26 grms. of bismuth). The precipitate, occasioned by the addition of the bismuth solution to the solution of phosphorite, is left standing till quite cold, and is then filtered off, the precipitate being washed with cold water. Next, the phosphate of bismuth is dissolved, while on the filter, in a few drops of hydrochloric acid, and that solution is treated with ammonia and sulphide of ammonium, and gently heated, until all the bismuth has been converted into sulphide. When this has been effected, the liquid is acidified with acetic acid, and next heated to near the boiling-point; the precipitate is then collected on a filter, the last traces of sulphuretted hydrogen being eliminated by a few drops of chlorine-water. The phosphoric acid is estimated in the acetic acid solution by the well-known uranium process.

Different Methods of the Estimation of Manganese.—E. Escher and G. Rumpf.—The authors have tried comparatively, by means of a series of experiments, the following methods of the estimation of manganese:—Method of Fresenius and Will; method by which the manganese is placed in an hydrochloric acid solution of protochloride of iron, the quantity of non-oxidised iron being estimated; the method whereby, by the aid of hydrochloric acid, chlorine is developed from the manganese, and that gas taken up by hydrate of lime, followed by the estimation of the quantity of hypochlorite of lime thus produced; lastly, Bunsen's method, consisting in the evolution of chlorine from the manganese, and the passing of that gas into a solution of iodide of potassium, and estimation of the quantity of iodine set free. The authors found that only the methods of Fresenius and Will, and that of Bunsen, yield reliable results. They employed, for trial, the samples taken from one and the same large parcel of manganese, and state that the largest difference of the results obtained by applying the various methods several times were as follows:—

	Average.	Greatest difference between experimental results.
	per cent.	per cent.
Fresenius and Will	63·50	0·04
With protochloride of iron	62·06	1·15
As hypochlorite of lime ..	60·90	5·24
Bunsen's method	62·74	0·03

Analysis of Substances which on being Heated with Hydrochloric Acid yield Chlorine.—Dr. R. Fresenius.—In order to prevent the running back of the solution of iodide of potassium in the performance of Bunsen's titration method, the author proposes to prevent this by the addition of a few lumps of magnesite (compact native carbonate of magnesia) in the flask, the effect being the slow but steady evolution of carbonic acid gas, which, by the pressure it exerts, prevents the running back of the iodide of potassium solution.

Preparation of Pure Hydrochloric Acid.—Dr. R. Fresenius.—By means of direct experiments, the author has found that the method proposed by P. W. Hofmann for the preparation of pure hydrochloric acid (this method is not described, but it would appear to be based upon the driving off of hydrochloric acid gas from the crude acid as obtained in alkali works by the aid of heating with sulphuric acid, and the condensation of the gas thus set free in pure water), does not yield hydrochloric acid free from arsenic or free chlorine in case the crude acids, sulphuric and hydrochloric, employed, contain arsenic or the last named free chlorine.

Estimation of Phosphoric Acid as Ammonio-Magnesium Phosphate.—W. Heintz.—The main point of interest in this paper is, that the precipitate of ammonio-phosphate of magnesium, obtained in the generally known method of the estimation of phosphoric acid has to be re-dissolved in dilute hydrochloric acid after having been washed with dilute ammonia in order to get rid of a portion of the magnesia, which, in the first precipitate, is carried down, but not combined with phosphoric acid.

Estimation of Nitric Acid in Potable Water.—Dr. F. Goppelsröder.—The author states that having an opportunity to test Dr. Marx's plan of the estimation of nitric acid in water by means of an acid solution of indigo, he discovered that this plan yields too low results, while, moreover, the nitrites present in water are found to interfere with this process. This difficulty the author overcomes by making use of a titrated solution of permanganate of potassa applied to the water after the addition of a few drops of dilute sulphuric acid.

Preliminary Notice.—H. Hübner and C. Müller.—The authors state that they are engaged in experimenting upon the action of sodium upon epichlorhydrine; several new compounds are thereby formed, among which are the alcohols, $C_6H_{12}O_2$ and $C_6H_{14}O_3$; the authors give this brief notice because at present they are prevented from proceeding with these researches.

Annalen der Chemie und Physik, von Poggendorff, No. 8, 1870.

This number contains the following original papers and essays:—

Thermo-Chemical Researches.—J. Thomsen.—This paper is the continuation of the author's very lengthy essay on this subject, this present portion being divided into the following sections:—Researches on formic, acetic, oxalic, succinic, tartaric, and citric acids; researches on chromic, carbonic, and hydro-sulphuric acid; results of experiments relating to the neutralisation and basicity of the acids.

Researches on Electric Discharges.—W. v. Bezold.—This paper is illustrated with engravings absolutely required for the proper understanding of its contents; the results arrived at by the author's experiments may be summarised as follows:—When there are open to an electric discharge, after the breaking of an electric spark, two ways towards earth, one of which is longer than the other, the longer way being interrupted by a test-plate (Probeplatte), the result will be the division of the discharging current, if the distance the electricity passes before striking be small, but if that distance be large the electricity takes the shortest way, and carries even along with it the same kind of electricity from the longer way; if an electric current is conducted on to a wire insulated at its end, the electricity is reflected at that end, and there ensue a series of phenomena of alternating discharges; an electric discharge is carried through wires of the same length with the same velocity, irrespective of the material these wires are made of.

Electro-Motive Force of the Electric Light.—W. v. Bezold.—An algebraico-physical paper.

Caloric Capacity of Water when near its greatest Density.—L. Pfaundler and H. Platter.—This memoir contains essentially a lengthy series of results of experiments exhibited in a number of tables containing several columns of figures.

Acoustical Studies on Flames.—E. Villari.—A lengthy essay illustrated by a series of engravings.

Relation Existing between Tranverse Contraction and Longitudinal Dilatation.—A mathematico-physical paper.

Compensation of an Optical Change of Phase.—J. L. Sirks.

Reply to M. Most.—L. Boltzmann.—An algebraical paper, an observation also referring to the following.

Contribution to the Molecular Theory, and to the Doctrine of Electricity.—L. Lorenz.

Theory of Poisson Relating to the Temperature of the Globe.—O. Frölich.—A discussion on the value of certain algebraical formulæ put forward by M. Poisson to explain the phenomena of the disposition of the temperature over our globe.

Curious Effects Produced by Lightning.—Dr. J. G. Fischer.—The author describes at great length the effects caused by the lightning striking his house, a detached residence situated at a distance from Hamburg, on the 17th June last; the lightening first struck and demolished a stack of chimneys, and next found its way to the soil along a zinc pipe for conveying the rain-water from the roof downwards; the pipe alluded to, previously sound, was perforated in three places in a very curious manner; at one of the holes the metal was forced outward, while at the two other holes the metal had been forced inward in such a manner as to close the tube for the passage of water, at the point where the tube reached at the bottom the earthenware drain-pipe; the latter was smashed, the soil which covered it having been scooped out; no fire ensued by the striking of the lightning, nor was fusion of metal anywhere perceptible. The author enters into lengthy details on the magnetic action of the lightning upon steel and iron objects; none of the parties present in the house at the time of the occurrence were at all injured.

Relation of the Specific Heat of the Air when under a Constant Pressure and Volume.—Dr. Witte.—A short letter to the editor correcting some algebraical formulæ formerly published.

Minimum of Prismatic Aberration.—A. Kurz.

Preparation of a Fluid suitable for the Formation of Plateau's Equilibrium Figures without Gravity.—R. Böttger.—Take previously flaked palm-oil soap, place it in a large flask, and pour over it cold distilled water so as to prepare a cold saturated solution of soap, which should be filtered through grey filtering paper; there is next added about one-third part of the bulk of the fluid of pure concentrated glycerine; before using this fluid it should be well shaken up; the author states that soap bubbles of more than a foot diameter can be made with this fluid, and that such bubbles may be obtained attached to a piece of iron wire; if protected from currents of air the bubbles will persist for even ten hours.

Pharmaceutische Zeitschrift für Russland, No. 10, 1870.

This number contains the following original papers:—

Various Methods of Testing the Value of Opium, and more especially on the method prescribed for that purpose in the New Pharmacopœia of the Austro-Hungarian Monarchy.—A. Siersch.—This lengthy paper contains a review of the comparative value of the various methods proposed at different periods, and by different authors, for the estimation of the value of opium, as compared with

the method directed to be applied for this purpose by the pharmacopœia above mentioned.

Chemical Researches on the Fruits of the Laurel Plant.—Dr A. Casselmann.—We have already noticed this essay from another periodical. The essay itself is a separate work written in Russian.

NOTES AND QUERIES.

Love's "Dyer and Scourer."—Can any of your readers tell me where I can get the above work?—X. Y. Z.

Estimating Tartaric and Citric Acids.—Can you refer me to any work giving any recognised method of estimating tartaric and citric acids in the crude substances—argol, &c.?—A. J. M. EDGER.

Salaries.—"Student X." will feel greatly obliged if any reader of the CHEMICAL NEWS will give him some idea of the salary a B.Sc. Lond. Univ. might reasonably expect to receive for his services in an average laboratory, London or provincial.

Ethers in Wine.—(Reply to "H. T. B.")—The paper you refer to—viz., "Sur la Proportion des Ethers dans les Vins et sur quelques uns des Changements qui s'y Produisent," by M. Berthelot, is to be found in *Comptes Rendus des Séances de l'Academie des Sciences*, vol. lvii., pp. 231 and 287.

Aluminium in Batteries.—I have tried the metal aluminium as a substitute for platinum, in a Grove's battery, and the experiment is quite successful. Two small cells, the size of the Al plates being 4 inches by 1¼, decomposed water very energetically. The metal aluminium possesses the advantage of costing (for equal surfaces) about one-tenth the price of platinum. I obtained it, price 5s. per ounce, cut to size as ordered.—W. NETTLETON.

Tabachere.—(Reply to Wm. Lant Carpenter.)—Tabasheer, as it ought to be written, is a Persian word signifying a concretion found in the joints of the bamboo, *Bambusa arundinacea*, said by Dr. Russell to be the juice of the plant thickened and hardened, by others to be pure silica. It is valued, in the East Indies, as a medicine for the cure of bilious vomitings, &c., but its effects are more imaginary than real. It appears to be mainly composed of siliceous matter which the plant is unable to incorporate in its tissues; its peculiar optical properties have been described by the late Sir David Brewster.

Phosphate of Lime.—I should be glad to be informed of the formula and equivalents of "bi-phosphate of lime" and "tri-phosphate of lime" respectively, anhydrous phosphoric acid being $P_2O_5=142$. In Williamson's "Chemistry" I find bi-phosphate given as $CaH_4P_2O_8=234$, and tri-phosphate, $Ca_3P_2O_8=310$, having the relation of 100 : 132·5, but in all analyses I have seen I find the equivalents taken as related to each other as 100 : 156 or 157. I should, therefore, be thankful to know the explanation of this apparent error. Is it connected with a professional or commercial usage?—W. TATE.

Deodorising Oil. — Sulphuretted Hydrogen Apparatus. — Can any of your correspondents inform "Nindex" (1) of a method for deodorising rape and colza oils? so as to fit them for use in perfumery, &c., where their peculiar odours are detrimental. Animal charcoal has been tried; its action is decidedly an improvement, but on rubbing the oil so treated between the hands the odour is then as persistent as before treatment. (2) What is the best form of H_2S apparatus for use in a small laboratory, opening on to a pharmacy where the public are continually coming in and going out, so as to prevent annoyance by its disagreeable odour. There is one figured by Fresenius and devised by Pohl; have any of your correspondents experience of the same, as that seems to be, theoretically, the best yet made known to me.—NINDEX.

MEETINGS FOR THE WEEK.

MONDAY, 7th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action."
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 8th.—Ethnological, 8.
—— Photographic, 8. Exhibition.
THURSDAY, 10th.—London Institution, 7½. Dr. W. H. Stone, M.A., "On the Acoustics of the Orchestra."

TO CORRESPONDENTS.

J. W. M.—You will find the information you require in Richardson and Watts's "Chemical Technology."

M. M. P. M.—(1) *Proceedings of the Royal Society*. (2) Thompson's "History of Chemistry."

The Secretaries of the Ethnological and Photographic Societies are thanked for the cards of admission which they have been good enough to send.

T. Corbett.—A reply has been sent by post.

Post Office Irregularities.—Since the introduction of the halfpenny postage, the complaints of delay in the transmission of the CHEMICAL NEWS have become very numerous. Our subscribers may rest assured that in all cases the fault rests with the Post Office authorities, and complaints should be addressed to them. We suffer equally in the irregularities in the receipt by post of our own periodicals.

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THE CHEMICAL NEWS.

VOL. XXII. No. 572.

ON A CONVENIENT FORM OF SPECTROSCOPE FOR USE IN A LABORATORY.

By JOHN BROWNING, F.R.A.S.

THIS spectroscope is so constructed that it may be kept in close proximity to a chemical laboratory without injury. The prism is provided with a cover, which should be put on with a little bees'-wax; or, better still, bees'-wax and tallow. This prism, with cover complete, can be removed and replaced without deranging the adjustment of the instrument, to allow of a bottle prism being substituted for the purpose of taking the refractive index or dispersive power of any liquid. The stand of the instrument is of wood, and the whole is enclosed in a circular cover which fits tightly round the base of the instrument, and has no other joint or opening.

REMARKS ON RICININE.

By RICHARD V. TUSON, F.C.S.,
Professor of Chemistry in the Royal Veterinary College.

AMONG the "Chemical Notices from Foreign Sources" which appeared in the CHEMICAL NEWS of the 21st of October last will be found an extract from an article entitled "On Ricinine and the Active Principles of Ricinus Seeds," published in the *Pharmaceutische Zeitschrift für Russland*, No. 1, 1870. This extract contains the following statement:—"As regards the ricinine of Dr. Tuson, prepared by the author (Dr. E. Werner) in large quantity, and according to Dr. Tuson's directions, it is stated that ricinine is not an alkaloid, and, moreover, a substance which contains a considerable quantity of ash; and the author, after carefully made analyses, comes to the conclusion that Dr. Tuson's ricinine is a compound of magnesia and of an organic acid, the formula of this body being—

$$C_{11}H_{20}O_{10}Mg_2 + 6H_2O.$$"

That the bodies obtained by Dr. Werner and myself from castor seeds are totally different I hope to render evident in the present communication.

I have in my possession two small specimens of ricinine; one was prepared from the so-called castor cake obtained from India, the other from castor cake obtained from Italy. These specimens possess the undermentioned properties:—

1. Cautiously heated on a glass plate they melt and form a colourless mobile liquid, which, on cooling, solidifies into a whorl of acicular crystals.

2. Heated between two watch-glasses they sublime, apparently without decomposition.

3. Strongly heated on platinum foil, they first melt, then burn with a highly luminous flame, and *leave no ash*.

4. Heated with solid potassium hydrate, they evolve ammonia, proving that they *contain nitrogen*.

5. On estimating the amount of nitrogen by Péligot's method, the specimen of ricinine procured from Indian castor-cake contained 20·79 per cent, while that from Italian cake contained 20·39 per cent.

6. A solution of ricinine in hydrochloric acid mixed with one of platinic chloride yields, on evaporation, well defined orange octahedra.

7. Cold saturated aqueous solutions of ricinine and mercuric chloride, if mixed together and allowed to stand, deposit fasciculi of acicular crystals.

A comparison of the foregoing epitomised account of ricinine with the description of the magnesium compound obtained by Dr. Werner from ricinus seeds, therefore clearly indicates that the two bodies are entirely different.

That ricinine is entitled to the appellation of alkaloid I hope yet to demonstrate by its complete investigation so soon as I shall become possessed of a large supply of castor cake, now, I believe, on its way from Calcutta.

ON NEW ANALYTICAL PROCESSES.

By J. H. TALBOTT.

I. *On the Precipitation of Zinc and Manganese as Sulphides.*

ZINC is thrown down from cold solution by an alkaline sulphide in the form of a slimy mass which settles slowly and is extremely difficult to wash. The precipitation is, however, more complete than when sodic carbonate is used, and may be rendered very easy and rapid by the following process:—The solution of zinc, if acid, is to be neutralised as nearly as possible by sodic or ammonic carbonate. To the boiling solution, sodic or ammonic sulphide is to be added, a large excess being very carefully avoided. The white precipitate, on continued boiling, soon becomes granular, and settles readily. The supernatant, clear liquid is then to be tested with a drop of the alkaline sulphide, to be sure of complete precipitation, and the sulphide then washed with hot water by Bunsen's method. The filtrate is perfectly clear, and absolutely free from zinc; the washing is easy and rapid. The sulphide of zinc is then to be partially dried with the filter, in the manner recommended by Bunsen, brought into a porcelain crucible, and ignited, at first gently, and afterwards strongly, with free access of air. The expulsion of the last traces of sulphuric acid is much facilitated by occasionally dropping fragments of ammonic carbonate into the crucible. Pure ZnO finally remains, the ignition being continued until a constant weight is obtained. In this manner the following results were obtained:—

gr.			gr.	
0·3216	pure ZnO	gave	0·3216 =	100·00 per cent
0·3208	,,	,,	0·3209 =	100·03 ,,
0·2412	,,	,,	0·2410 =	99·91 ,,
0·1785	,,	,,	0·1784 =	99·94 ,,

In zincic sulphate, which had probably lost a little water—

gr.		gr.	
0·6485	gave	0·1851 ZnO =	28·54 per cent.
0·6510	,,	0·1858 ,, =	28·54 ,,
0·8198	,,	0·2338 ,, =	28·52 ,,

The formula requires 28·29 per cent ZnO. The advantages of this process over the older methods of precipitating in the cold are, I think, very evident, even if only the saving of time be taken into consideration.

Manganese may be precipitated completely from its boiling solutions by precisely the same process. The flesh-coloured sulphide is granular, and sometimes even sandy, though not distinctly crystalline, and may be washed with the utmost facility. The precipitated sulphide, after washing upon a filter, is to be re-dissolved in chlorhydric acid, and precipitated as ammonio-phosphate in the manner proposed by Professor Gibbs. To test the method with a perfectly definite salt of manganese, manganous pyrophosphate was selected, dissolved in dilute chlorhydric acid, and the solution nearly neutralised by sodic carbonate. To the boiling solution, sodic sulphide was then added, and the manganese finally weighed—in one analysis as pyrophosphate, in another as anhydrous sulphide—by ignition in a current of SH_2. In this manner—

0·3132 gr. $Mn_2P_2O_7$ gave 0·3126 gr. $Mn_2P_2O_7$ = 49·56 per cent MnO.

0·3786 gr. $Mn_2P_2O_7$ gave 0·2310 gr. MnS = 49·65 per cent MnO.

The formula requires 49·64 per cent MnO. It is, perhaps, worthy of notice that ammonic sulphide does not completely decompose manganous pyrophosphate under the circumstances above described. The greater portion of the salt is precipitated at once as crystalline ammonio-phosphate of manganese.

II. *On the Quantitative Separation of Tin and Tungsten.*

The quantitative separation of tin from tungsten has always been regarded as a difficult problem not hitherto solved in a satisfactory manner. The following method will, I think, be found to leave nothing to be desired as respects both ease and accuracy. It depends upon the fact that stannic oxide, SnO_2, is reduced by potassic cyanide with great facility; while tungstic acid, WO_3, undergoes no reduction, even when heated with the cyanide to a high temperature. The oxides of tin and tungsten are to be heated in a porcelain crucible with three or four times their weight of commercial potassic cyanide, previously fused, pulverised, and thoroughly mixed with the two oxides. The mass is kept fused for a short time, when the tin separates in the form of metallic globules, while the tungstic acid unites with the alkali of the potassic cyanate and carbonate present. After cooling, the mass is to be treated with hot water, which dissolves the alkaline tungstate and other salts, and leaves the tin as metal. This is to be filtered off, washed, dried, and weighed as stannic oxide, after oxidation in the crucible with nitric acid. The tungstic acid is most conveniently estimated by the difference, but may of course be precipitated by mercurous nitrate, after boiling the solution with nitric acid to decompose the excess of potassic cyanide present, and then re-dissolving the precipitated tungstic acid by means of an alkali. To test the method, weighed portions of pure stannic and tungstic oxides were mixed and treated as above—

0·6662 gr. SnO_2 and 0·5880 gr. WO_3 gave 0·6679 gr. SnO_2 = 53·24 per cent. The calculated percentage of stannic oxide is here 53·11.

0·7098 gr. SnO_2 and 0·5460 gr. WO_3 gave 0·7096 gr. SnO_2 = 56·51 per cent, the calculated percentage being 56·52.

0·5378 gr. SnO_2 and 0·4373 gr. WO_3 gave 0·5405 gr. SnO_2 = 55·43 per cent, the calculated percentage being 55·15.

0·5073 gr. SnO_2 and 0·4334 gr. WO_3 gave 0·5081 gr. SnO_2 and 0·4349 gr. WO_3. This corresponds to—

	Found.	Calculated.
Stannic oxide	54·01	53·92
Tungstic oxide.. ..	46·23	46·08
	100·24	100·00

As it might, perhaps, be objected to the examples given above that I employed only purely mechanical mixtures of stannic and tungstic acids, and that this is not the case which occurs in practice, I made the following additional analyses:—Portions of the two metallic oxides were fused in a silver crucible with pure sodic hydrate; the fused mass was then dissolved in water, and the two oxides precipitated together from the solution by nitric acid with the usual precautions. The ignited mixed oxides were then fused with potassic cyanide, as above. In this manner—

0·7292 gr. of a mixture of SnO_2 and WO_3 gave 0·4211 gr. SnO_2 = 57·74 per cent.

0·9826 gr. of the same gave 0·5661 gr. SnO_2 = 57·61 per cent.

Tin cannot be separated from molybdenum by fusing the mixed oxides with potassic cyanide, as the molybdic acid is always more or less completely reduced to a lower oxide.—*American Journal of Science.*

THE ISOMERS OF AMYL.

By HERBERT McLEOD, F.C.S., &c.

HAVING been much interested by Mr. O. Loew's communication, "On the Number of Isomeric Bodies," which appeared in the CHEMICAL NEWS of Oct. 7, may I be permitted to point out that the number of isomers of amyl has been somewhat over-estimated? for in the series of formulæ given, several cases occur in which the same compound is repeated, though in a different form. Mr. Loew professes to discard what he names the "theory of agglomeration and of the so-called binding and linking of atoms," though in the next column he speaks of two atoms of the same hydrocarbon being connected by a diatomic "radical," and follows Professor Kolbe in considering the hydrocarbons to be analogous to diamines and triamines which have a well-defined constitution. He thus virtually concedes the principle that he pretends to eschew. These differences of opinion on the rational formulæ of compounds are often mere questions of words and expressions, the same facts being symbolised in different ways; the formulæ indicating the same arrangement of the atoms among themselves, though the symbolic representations at first sight appear to differ entirely. Mr. Loew's formulæ will be found, on inspection, to be based on what has been termed the quadrivalent or tetrad character of carbon, and this will be seen by comparing the following corresponding expressions which have been suggested by various chemists. In the first place will be found the formulæ of Mr. Loew; in the second, a kind of abridged graphic formula, now much used, in which the symbols of the atoms which are directly combined with one another are joined by hyphens or short strokes; and in the third, the notation proposed by Dr. Frankland (*Journ. Chem. Soc.*, *N. S.*, iv., 372), in which the grouping element is placed at the commencement of each line, and is directly combined with all the elements and radicals following it in the same line, the brackets indicating that the carbon atoms at the beginning of each line are directly combined with those above and below. To take the formulæ in the order in which they are placed in Mr. Loew's paper:

Isomers of Amyl. C_5H_{11}.

I. Monocarbolic Radicals.

a. Primary.

Mr. Loew's formulæ. Abridged graphic. Dr. Frankland's.

(1.) $\left.\begin{matrix} H_3C \\ H_2 \end{matrix}\right\} C \left\{ \begin{matrix} C \\ H_2 \end{matrix} \right\} C \left\{ \begin{matrix} C \\ H_2 \end{matrix} \right\} C$ $\quad C\equiv H$, $C=H_2$, $C=H_2$, $C=H_2$, $C=H_2$ $\quad \left\{\begin{matrix} CH_3 \\ CH_2 \\ CH_2 \\ CH_2 \\ CH_3 \end{matrix}\right.$ or $\left\{\begin{matrix} CH_2Me \\ CH_2 \\ CH_2 \\ CH_3 \end{matrix}\right.$

(It is by the last carbon in Mr. Loew's, and by the lowest one in the other two formulæ, that the radical is united to other radicals in amyl compounds; these are, consequently, semi-molecular formulæ, and represent unsaturated bodies.)

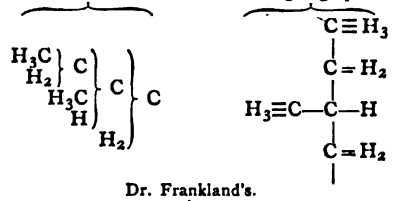
Mr. Loew's. Abridged graphic.

(2.) $\left.\begin{matrix} H_3C \\ H_3C \\ H \end{matrix}\right\} C \left\{ \begin{matrix} C \\ H_2 \end{matrix} \right\} C \left\{ \begin{matrix} C \\ H_2 \end{matrix} \right\} C$ $\quad H_3\equiv C-\overset{H}{\overset{|}{C}}-C\equiv H_3$, $C=H_2$, $C=H_2$

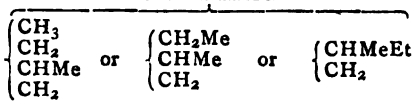
Dr. Frankland's.

$\left\{\begin{matrix} CH_3 \\ CHMe \\ CH_2 \\ CH_2 \end{matrix}\right.$ or $\left\{\begin{matrix} CHMe_2 \\ CH_2 \\ CH_2 \end{matrix}\right.$

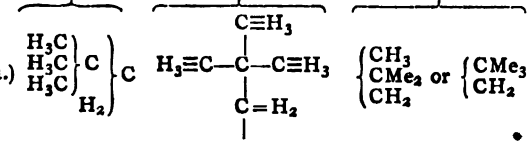
(3.) Mr. Loew's. Abridged graphic.



Dr. Frankland's.

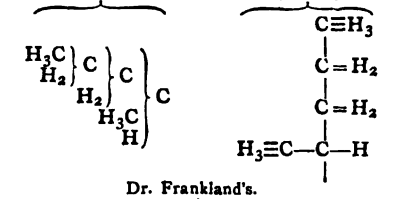


(4.) Mr. Loew's. Abridged graphic. Dr. Frankland's.

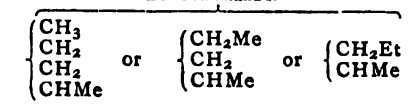


b. Secondary.

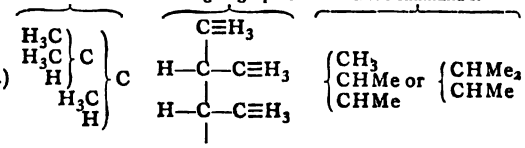
(5.) Mr. Loew's. Abridged graphic.



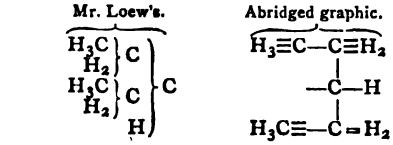
Dr. Frankland's.



(6.) Mr. Loew's. Abridged graphic. Dr. Frankland's.



(7.) Mr. Loew's. Abridged graphic.



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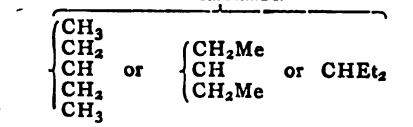
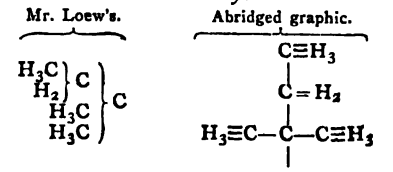


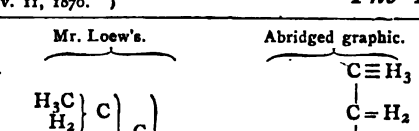
(In the last formulæ, it is the centre atom of carbon that unites with other radicals.)

c. Tertiary.

(8.) Mr. Loew's. Abridged graphic.

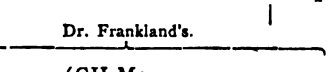


(8.) Dr. Frankland's.

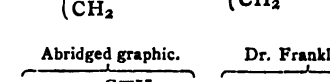


II. Dicarbolic Radicals.

These, we are told, resemble, in constitution, the diamines, two atoms of carbon being connected by a diatomic radical. As an example of a diamine, we will take ethylene-diamine—



which may be considered as a derivative of diammonia—



but the diamine may equally well be regarded as obtained from two molecules of ammonia—

by the substitution of the diatomic radical ethylene for one atom of hydrogen in each of the ammonia molecules—

and thus connecting the atoms of nitrogen.

This latter assumption is the most probable, as diammonia does not exist; and the second formula indicates that the nitrogen atoms are not directly combined with one another.

On treating Mr. Loew's formulæ for the dicarbolic isomers of amyl in a similar manner (and which obviates the necessity of assuming the existence of *di-marsh gas*—

it will be seen that they are identical with the preceding monocarbolic bodies.

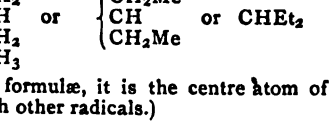
In the first, the diatomic radical is—

and, as there remain five atoms of hydrogen to be divided between two atoms of carbon, two must be associated with one of the carbon atoms and three with the other.

Dicarbolic Radicals.

a. Primary.

(9.) Mr. Loew's.



Abridged graphic. Dr. Frankland's.

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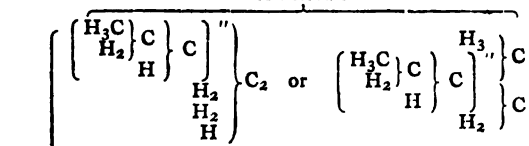
(10.)

Mr. Loew's.



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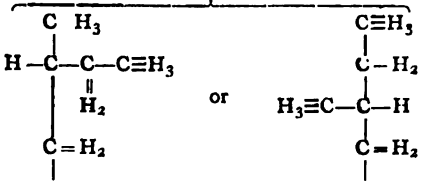

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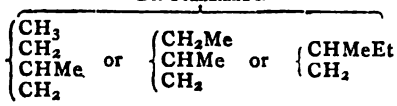

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b. Secondary.

(11.)

Mr. Loew's.

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Dr. Frankland's.

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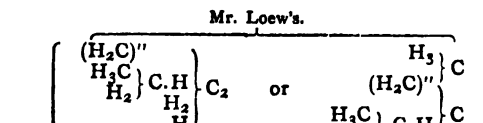
(12.)

Mr. Loew's.



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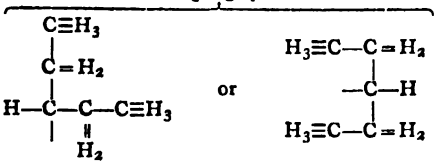

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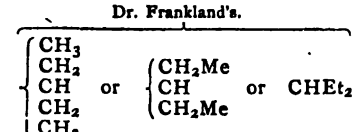

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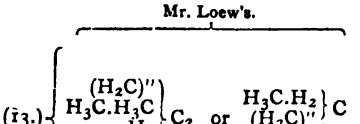
(13.)

Mr. Loew's.



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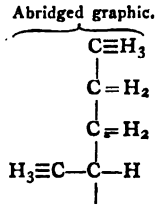

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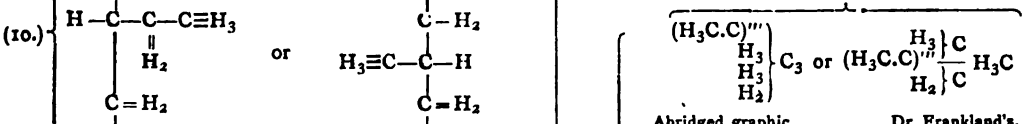
III. Tricarbolic Radicals.

By formulating these in a similar manner, we have—

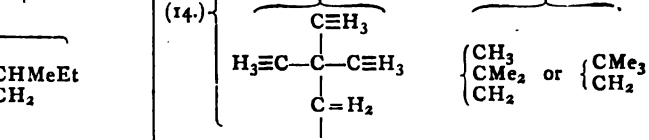
(14.)

Mr. Loew's.



Abridged graphic.

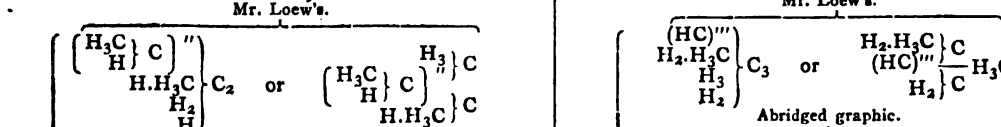
Dr. Frankland's.



This is identical with No. 4 and No. 9.

(15.)

Mr. Loew's.



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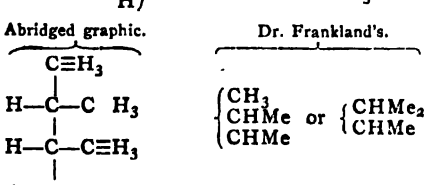
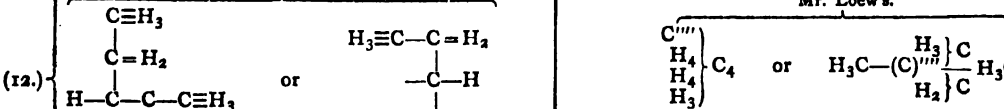


Dr. Frankland's.

This is identical with No. 3 and No. 10.

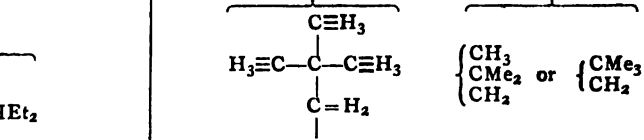
IV. Tetracarbolic Radical.

Mr. Loew's.



Abridged graphic.

Dr. Frankland's.



This is identical with No. 4, No. 9, and No. 14.

From this it will be seen that, with our present knowledge of the characters of carbon, we cannot conceive of more than eight isomers of amyl.

There is only one variety of methyl; one of ethyl, which may be viewed as methylated methyl, CH_2Me. There are two propyls:—normal propyl, which is ethylated methyl, CH_2Et, and isopropyl, or dimethylated methyl, $CHMe_2$. There are four butyls:—normal butyl, or propylated methyl, containing normal propyl,

$$CH_2Pr = CH_2(CH_2Et);$$

another primary butyl, containing isopropyl—

$$CH_2\beta Pr = CH_2(CHMe_2);$$

a secondary butyl, methylated ethylated methyl, CHMeEt; and lastly, a tertiary butyl, trimethylated methyl, CMe_3. In the eight amyls above given, we have in the four primary ones the four varieties of butyl, No. 1 containing normal butyl, No. 2 the isopropylated methyl, No. 3 contains methylated ethylated methyl, and No. 4 trimethylated methyl. Of the secondary amyls, the first, No. 5, contains methyl and propyl; the second, No. 6, methyl and isopropyl; and the third, No. 7, two of ethyl. In the tertiary amyl, No. 8, the three hydrogens of methyl are replaced by two of methyl and one of ethyl, it being dimethylated ethylated methyl.

These views will require to be very much extended if it should be distinctly shown that the four attractions of carbon differ, or, what comes to the same, that the four hydrogen atoms in marsh gas have different functions. Up to the present there are very few cases of isomerism which may not be explained by the assumption that these atoms are of equal value; there being, however, two most important exceptions in Bunsen's methylic bromide, and in the isomeric ethylic chloride obtained by acting on ethylic hydride by chlorine. If, however, the four hydrogen atoms in marsh gas have different properties, the number of isomers will be increased to a prodigious extent. By replacing one of these atoms by chlorine, four different methylic chlorides would be possible. In the next series the number of ethylic chlorides would be very much greater. The isomerism may perhaps be illustrated by numbering the four attractions of carbon, thus, $\overset{1}{4}C2$; then the four methylic chlorides will be formed by the $\overset{3}{C}$hlorine being in the position of one of the numbers 1, 2, 3, or 4, the three remaining positions being occupied by hydrogen; there will consequently be four varieties of the radical methyl depending on the attraction which is occupied in joining the group to other radicals. Now let us imagine the molecule of methyl in the free state produced by the union of two semi-molecules, by the attractions marked 1, we shall have $3\overset{4\ 2}{C}C3$. Three ethylic chlorides are now possible according as the chlorine takes a position at 2, 3, or 4. But the carbon atoms may be united by the attractions marked 2, the methyl $4\overset{1\ 3}{C}C4$ will thus be formed; this will also form 3 chlorides: the other two possible formulæ are $1\overset{2\ 4}{C}C1$ and $2\overset{3\ 1}{C}C2$, each giving three chlorides, or 12 in all. But we may go even farther; attraction 1 may unite with attraction 2, producing $3\overset{4\ 3}{C}C4$; and in a similar manner there might be formed—

$$3\overset{4\ 4}{C}C1,\ 3\overset{4\ 1}{C}C2,\ 4\overset{1\ 4}{C}C1,\ 4\overset{1\ 1}{C}C2,\ 1\overset{2\ 1}{C}C2.$$

Thus we should have ten varieties of hydride of ethyl, or methyl, each capable of producing three ethylic chlorides, or a total of no less than thirty. In the propyl series the number would be vastly greater, but it will not be necessary to occupy more space in developing these isomerisms, more especially as they are perfectly hypothetical.

From the foregoing it will be seen that the lightly esteemed "theory of agglomeration and of the so-called binding and linking of the atoms," or, as it has been termed, "the interlacement of tentacles," is competent to explain almost all the isomerisms with which the chemist is already acquainted and to direct the experimenter on the track of new discoveries. The very few cases of isomerism in the methyl and ethyl series that have been clearly established would seem to indicate that there is no need to resort to such complicated explanations as those just given; but it must be remembered that if such isomers did exist their differences would be very slight, and we may not at present have arrived at the knowledge of the means of distinguishing them. Already, in the case of two of the valeric acids, molecular weights, vapour densities, specific gravities, boiling points, and odour have failed us, and recourse must be had to the action of the bodies on polarised light in order to distinguish them from one another.

Royal College of Chemistry, London.
October 16, 1870.

ON SOME OF THE COLOURING MATTERS OF MADDER.

By Dr. F. ROCHLEDER.

WHEN madder has been treated with mineral acids aided by heat, or, as it is technically called, has been converted into garancine, it contains, beside alizarine and purpurine, a yellow-coloured crystalline matter, which, in the unground root, is present as a glucoside. The quantity, however, of this substance is only small, and it requires thousands of pounds' weight of madder to obtain a few drachms of the mixture containing this yellow material. I received, from M. W. Brosche, a manufacturer, the raw material, which served me for the purpose of my experiments, in the shape of a brownish yellow, hard, specifically light, and readily pulverisable substance. I cannot here enter into any discussion, nor explanations, as regards the relation of the substances which I isolated from this raw material to the bodies Dr. Schunk found in his so-called rubian, and to the materials found by Dr. Schützenberger in commercial purpurine, since the analyses of the substances alluded to do not agree sufficiently mutually for this purpose. The raw material I obtained was soluble in caustic soda solution, exhibiting a blood-red colour; hydrochloric acid precipitates from this solution a bulky, gelatinous, dirty yellow-coloured flocculent matter, which, after boiling, loses its gelatinous property sufficiently to admit of collection on a filter, and of being readily washed after cooling. The solution in alkali, and the precipitation by acid, are required in order to render the material more readily acted upon by solvents. On being treated with baryta-water, the greater part of the material left on the filter is dissolved, while only a small quantity remains as a nearly black-coloured powder; the separation of these substances is effected by filtration. While I intend to say more about the blackish coloured substance hereafter, I for the present only occupy the attention of my readers with the four substances the baryta compounds of which are soluble in water. The blood-red coloured baryta-water solution is precipitated with hydrochloric acid, and the fluid containing the precipitate is heated to boiling, in order thereby to counteract the gelatinous consistency of the precipitate, which is next brought on to a filter and washed with water. The precipitate, while yet moist, was somewhat dried between folds of blotting-paper, and next heated with hydrate of acetic acid in sufficient quantity to effect a thorough solution; on cooling, this acetic acid solution solidifies, exhibiting crystalline structure. This material was placed on a filter and washed with cold acetic acid as long as the liquor running through exhibited the colour of a solution of bichromate of potassa. By this treatment, an amorphous, resinous substance, which is soluble in cold acetic acid is removed, while hardly anything else is rendered soluble. The reddish coloured solution thus obtained yields, on being diluted with water, a yellow-coloured glutinous precipitate, the quantity of which is, however, too small to make it worth while to treat it for any crystalline substances which might be contained therein. The lemon-yellow coloured mass which is left on the filter was first fractionally crystallised from a boiling mixture of acetic acid and water; next, the substances thus obtained were fractionally crys-

tallised by means of boiling alcohol; and were next, again, by means of partial solutions in alcohol and water, separated into various compounds. It would lead too far to explain here the applications of ammonia, carbonates and bicarbonates, chloride of iron, &c., used by me for the purpose of separating the substances. The four bodies which I have isolated from each other are, as regards their behaviour with solvents, so nearly related to each other, that their separation can only be effected by frequently repeated and tedious operations; and, as regards their properties, too, they are so akin to each other that only by a series of analyses I could find out whether they required more purification. I only obtained small quantities of the pure substances, and hence it was impossible so fully to investigate their relations as to deduct therefrom results in respect of their constitution. The product present in the mixture to the largest extent, after the removal of the resinous body alluded to, is isalizarine, because it has the same composition as alizarine, from which it is, however, distinguished by its blood-red colour when in solution in aqueous solutions of caustic soda and potassa, and by its red colour when dissolved in baryta water. The colour of this substance holds the middle between those of alizarine and purpurine. It does not dye cotton previously mordanted with iron or alumina mordants; it cannot be obtained in large crystals. The four following analyses refer to materials obtained by a different mode of preparation :—

	Calculated.		Found.			
			I.	II.	III.	IV.
C_{14} =	168	70·00	70·18	70·02	70·03	70·01
H_8 =	8	3·33	3·61	3·62	3·65	3·61
O_4 =	64	26·67	26·21	26·36	6·32	26·38
					2	
	240	100·00				

Isalazarine is accompanied by a second material present in the raw material, in so extremely small quantity that I could only just manage to make one analysis, which led to the formula $C_{15}H_{10}O_4$. This material may be readily confused with isalizarine, and its presence in that substance explains the somewhat too high proportion of H found in isalizarine. A third companion of isalizarine is hydrisalizarine; its colour is rather more bright yellow than that of isalizarine. It (hydrisalizarine) is soluble in a boiling solution of perchloride of iron, with a dark brown colour; it partly precipitates on cooling, partly on addition of a few drops of hydrochloric acid, in the shape of a bright yellow-coloured flocculent matter; it is not at all changed or altered in any way by its solution in the chloride. Four analyses led to the formula $C_{18}H_{18}O_8$. When alizarine is written—

$$C_{14}\begin{cases} H_6 \\ (OH)_2 \\ O \\ O \end{cases} > = C_{14}H_8O_4,$$

hydrisalizarine is expressed by—

$$\begin{matrix} C_{14}\begin{cases} H_6 \\ (OH)_3 \\ O \end{cases} \\ C_{14}\begin{cases} O \\ (OH)_3 \\ H_6 \end{cases} \end{matrix} > C_{28}H_{18}O_8.$$

The fourth companion of isalizarine and the two other substances alluded to is homologous with hydrisalizarine, according to the formula $C_{29}H_{20}O_8$. When this substance is kept for some time at from 118° to 120°, it loses OH_2, thereby assuming a more dark colour. I take this opportunity of calling attention to the composition of ruberythrinic acid, found by me now many years ago in madder; its composition is correctly expressed by $C_{20}H_{22}O_{11}$. By the action of acids, this substance, as was then pointed out by me, is converted into alizarine and sugar, according to the following formula :—

$$C_{20}H_{22}O_{11} = C_{14}H_8O_4 + C_6H_{12}O_6 + OH_2.$$

—*Berichte der Deutschen Chem. Gesell. zu Berlin.*

ON FERMENTATION.*

By Professor A. W. WILLIAMSON F.R.S.

Lecture I.

I have sometimes wished, when building castles in the air, that I could, after a few hundred years, come back and see the state of science at that time. I am convinced that those who will look back, from such a period as a few hundred years hence, at the present state of our knowledge of nature in any one department will be surprised at its smallness; in fact, even now, when we work at all earnestly at any one part of the field of nature, we cannot refrain from feeling how little is our knowledge compared with our ignorance. But, if that is generally the case, I think it is peculiarly the case in those studies in which life is concerned; and the phenomena of fermentation have that peculiarity that they consist in processes in which vital organisms are concerned, and in which there is every reason to believe that vital organisms, or living beings, take an active and leading part. I need not say that, for that reason, the explanations which we have, even of the simplest and best known of the phenomena of fermentation, are, as yet, mere sketches of the reality. It is, however, not the less useful or the less important to know them for that reason.

When we chemists are classifying substances, we adopt a principle of classification which I think is almost inevitable, but it may be as well that I should mention what it is. We put the simple things together, and the complex or difficult things together, and then we try to put between them, in as regular an order as possible, the intermediate links of the chain by which they can be connected; and I believe that our best—I might almost say our only—explanations consist in thus arranging, in a natural order, the facts which we have to consider, and then viewing them, and stating what we see, in the clearest and least ambiguous terms. Now, the term "organic," as applied to a certain class of chemical substances, might be replaced—and I think, for some purposes, ought to be replaced—by the term "complex." The substances which we are in the habit of including under the term organic are peculiarly complex; in fact, they are the most complex with which we have to do. The phenomena of fermentation relate mainly to them, and consist principally of a process of change—the breaking-up of those organic bodies into rather less complex substances than themselves—a process of partial analysis. Of course, when I say that, I give what I conceive to be a characteristic idea of the general method, and I must not be supposed to assert that all processes of fermentation are analytical.

Amongst the characteristics which I think are particularly useful and interesting, as serving to distinguish organic from inorganic, complex from simple substances, is their different behaviour under heat. I have found it exceedingly interesting and instructive to bear in mind the fact that, while simple and inorganic compounds, as we generally call them, are sometimes destroyed and resolved into other compounds by the action of a high temperature, yet many of them are not. Amongst inorganic substances we find some which are broken up or changed by exposure to a high temperature, but there are others which can stand even the highest temperature without undergoing any permanent change; that is to say, they return, on cooling, to the same state in which they were before the heat was applied. With organic substances that is not the

* The Cantor Lectures. Delivered before the Society of Arts.

case. All organic bodies are broken up into minute particles, and assume new arrangements, when they are heated to a sufficiently high temperature; and that is, I think, a distinction which is of considerable theoretical, as well as, perhaps, of some practical, importance.

The processes of breaking up which are effected by heat upon organic bodies are, in the very great majority of cases, different from those which are effected by the action of these wonderful little organisms, the ferments; and it is a peculiarity of the action of the ferments that they effect the breaking up—the analysis—of complex organic substances, and form products which, for the most part, we have obtained from those materials by no other process.

Amongst the processes of fermentation, there is one which, from its pre-eminent importance, and from the fact that we have had occasion to study it more fully than any other, ought to be first mentioned. I allude to the process of fermentation by which alcohol is formed artificially. I may say, indeed, it is the only process by which alcohol is ever made. It is a process which consists in breaking up some kind of sugar, for sugar is a word which, although popularly restricted to one particular substance which is extracted sometimes from the sugar-cane and sometimes from beet-root, is used by chemists in a more general sense, serving to characterise a family of bodies which have much in common with one another, being for the most part all of them sweet, and containing the same elements, but in slightly different proportions. They all possess many properties which are of some importance. These different kinds of sugar are broken up by the action of ferment into alcohol, and also into another product, carbonic acid gas, which has been long known, and for a long time the process of alcoholic fermentation was supposed to consist simply in a separation of sugar into these two products, alcohol on the one hand and carbonic acid on the other. A more careful examination of the products has shown, however, that these two never appear alone. I believe I may safely say, from the researches of Pasteur and others, that no case of the formation of alcohol by fermentation has been known to occur in which several other products have not been formed simultaneously with these two. With regard to the difference of properties of these two bodies, there are one or two points of some little interest, especially this one, that whereas alcohol is an eminently combustible substance, and is well known to have properties of that kind, being frequently used as fuel, on the other hand, carbonic acid, the other chief product, is completely burnt—it is a substance incapable of undergoing any chemical change whatever analogous to combustion. Alcohol is a substance which I need not show you, although in its pure state it is not very common, but I will, in order to remind those of you who may be less familiar with its leading properties, make a little carbonic acid by a short process. I will put a little muriatic acid upon some white marble, and the apparent ebullition which you see takes place is known to you all as due to the liberation of carbonic acid. You might imagine the thing to be fermenting, only that the process in that case would be less rapid. Now, if I plunge this little burning paper gradually into the jar containing the carbonic acid, it will burn more and more faintly, and get extinguished when it enters the gas; it is totally impossible to set fire to the gas. And there is one other fact that we may notice at the same time—the great specific gravity which characterises this gas. I will show you that, in this way. I will go through the motion of pouring from this jar containing it into another smaller jar; and no doubt the heavy carbonic acid will pass from the jar in which I first collected it into the lower one, where we shall find it by means of the taper as before. You see that, on lowering the lighted taper into this small jar, it is extinguished as it was before. I will show you the test by which we usually discover the presence of carbonic acid. I have here some water containing lime in solution—some lime-water—and I will pour it into the large beaker-glass, in which there is probably still some carbonic acid left. You see the solution immediately becomes turbid, or, as we express it, a precipitate is formed by the combination of the carbonic acid with the lime-water. A compound is formed, which is nearly insoluble in the water, called carbonate, which goes down as a precipitate.

In addition to alcohol and carbonic acid, I ought to mention another kind of alcohol, which occurs to a considerable extent in some distilleries where raw grain or potato-starch is used. This substance imparts to the product a very unpleasant odour, and some unwholesome qualities. It is known by the name of fousel oil. It does not mix with water; and if I were to pour some of it on water, it would float, without dissolving to any considerable extent. There are some other products which are even more interesting and important; two especially I ought to mention. One is the clear substance which you see in this bottle, and which you might imagine to be oil; it is a fluid largely made now, and known by the name of glycerine, but in chemical language I should say that this was an alcohol. It is a substance which, by tasting, you might mistake for sugar, for it possesses a sweet taste, resembling sugar; but, to chemists, it is a kind of alcohol, and its appearance during fermentation together with ordinary alcohol is no doubt due to a process of the normal kind.

Another product which I might compare to the carbonic acid which I just now showed to you, is this beautiful crystalline acid substance, which has long been known by the name of succinic acid. It got that name from the fact that it was originally prepared from amber. By subjecting the amber to dry distillation, succinic acid, among other products, is formed. Glycerine and succinic acid, as well as common alcohol and carbonic acid, are always formed when any kind of sugar is made to decompose by the process which is termed alcoholic fermentation, and it is seldom that there are not other—and probably, in smaller quantities, several other—products formed besides those four. In fact, the different kinds of spirit which are obtained by the process of fermentation, and subsequent distillation—I mean those kinds of spirit to which no artificial flavouring is added (gin is a general name given to certain spirits which are flavoured by artificial means), such as brandy, rum, and others—owe their distinctive peculiarities to the presence of small quantities of volatile substances which are formed during the process of fermentation, regarding which a good deal has been observed, and several important facts have been collected.

There is another process of fermentation which I must mention, for it is important from its frequent occurrence, and that is a process by which another kind of sugar usually, but sometimes common sugar, is transformed. The substance which most naturally undergoes this fermentation is milk-sugar. These hard lumps in this bottle, which, if you were to take out and taste, you would not imagine to be sugar, are made by the crystallisation of the solid substance in whey. The whey is evaporated carefully to a small bulk, and this substance which results is known by the name of milk-sugar. When a solution of this is mixed with cheese, which is the best ferment for the purpose, it gradually turns acid. I dare say it is known to all of you that milk itself, which contains this body, and cheese, or rather caseine dissolved with it, together with the fatty globules of milk, when exposed to the air, turns acid. That acidity is due to a change which takes place in the sugar. The sugar disappears gradually, and is transformed into an acid substance, of which I have a little bottle here. It is a strong acid; and here, in another bottle, are a few of its salts—a lime salt and a zinc salt, which is a very beautiful and characteristic compound. I shall have occasion hereafter to show you a large bottle which is now at work, in which I dissolved, not this particular kind of sugar, but the ordinary sugar. I put with it a quantity of calcic carbonate, and some old lean cheese, with a considerable quantity of water. The mixture was kept at a temperature above blood heat for some considerable time, and a compound of lactic acid is being formed. That is a process analogous in its general features to the fermentation

which forms alcohol, but it is a change of sugar in which no alcohol is formed. Sometimes there is a trace of alcohol, but there is not necessarily any, and no carbonic acid is formed; but, instead of those products, the elements of the sugar break up into different groups and arrange themselves in another manner. That is really the nature of the process, as far as our most careful experiments have gone; and the acid which we make in that way, which is lactic acid, or acid of milk, is really sugar, of which the elements are arranged in a different way, so as to acquire acid properties.

The third process, which I must mention from its remarkable products, is one which, perhaps, in some respects, ought rather to be compared with putrefaction, for it is a process which has many of the most important characteristics of putrefaction. In order to deal with the question of fermentation generally, it is necessary to allude to some varieties of such chemical changes which are usually classed under the term putrefaction. As a general rule, I think the characteristic of processes of putrefaction is mainly the unpleasant nature of the products which are formed. It is not long since a distinguished chemist, in speaking of alcoholic fermentation, said that it is really a putrefactive process; and in its intimate nature it is, as far as we know, a process much like the truly putrefactive processes, and different from the processes of eremacausis or oxidation. This other process to which I allude consists in forming the acid substance which I have here, and which I will not open, because it is not a very pleasant body; it is a substance which is known, although I believe not very commonly, in butter. The peculiar rancid odour which butter acquires when it is kept too long, especially in warm weather, is due to a transformation of some of its materials into this particular acid, which Chevreul, a very distinguished French chemist, separated from butter, and he named it, from that circumstance, butyric acid. If we leave some of this product of the last fermentation—some of this lactate of lime, the lime-salt of lactic acid—under the same conditions in which it was formed, that is, if we leave it in the same vessel in which it had been formed from the milk or sugar, and leave cheese with it, and keep the mixture warm, the lactate will gradually decompose, and carbonic acid will be given off together with hydrogen gas; and, at the same time, we find that the lactic acid will be decomposed, and in place of it we get this butyric acid, and generally some valerianic acid and a little acetic acid.

(To be continued.)

ON THE ESTIMATION OF MANGANESE.

By Dr. MOHR.

Some discrepancies in the results of analysis of manganese, especially that imported from Spain, have been noticed, according as the method of analysis (quantitive estimation of peroxide of manganese) employed was that of Fresenius and Will, or that known as the iron test. The cause of this discrepancy has been found to be due to a larger or smaller amount of magnetic oxide of iron present in and along with the manganese ore. When the method of Fresenius and Will is applied to the estimation of manganese this admixture of oxide of iron is quite indifferent, because neither of the oxides of that metal exert any action upon oxalic acid; but when the so-called iron test is applied for the purpose alluded to, the protoxide of the magnetic iron ore is converted into chloride, and there remains, therefore, a correspondingly larger quantity of the double salt of iron which has been added. Since the same reaction occurs when such a manganese is applied for the manufacture of chlorine, and since the quantity of the latter gas set free is only that which remains after the oxidation of the magnetic iron ore, the manufacturer who purchases such manganese is entitled to pay for that article only its value as peroxide of manganese. It, however, frequently occurs that the mining and manufacturing interests here clash, and that, as a consequence, the ore proprietor will desire the value of his material to be estimated by the method of Fresenius and Will, while the manufacturer prefers that of the iron test. That right as well as equity are on the manufacturer's side is clear from the following instance:—Suppose a mixture of one atom peroxide of manganese, (MnO_2), and two atoms magnetic iron ore, $2(Fe_3O_4)$, or 27·3 per cent of the former along with 72·7 per cent of the latter; in such a mixture the method of Fresenius and Will will indicate with precision the amount of peroxide of manganese, but on adding hydrochloric acid to this mixture not a trace even of chlorine will be given off, since the free atom of oxygen of the peroxide of manganese is just sufficient for the oxidation of the two atoms of protoxide of iron of the magnetic iron ore; in the same way a mixture of manganese with protosulphate of iron or protocarbonate of that metal will be perfectly worthless as an article for the chlorine-making use.

The author recommends that manganese ores and samples of peroxide of manganese should be always tested, previous to analysis, with an astatic magnetic needle, and he further recommends as the best and surest method of analysis of peroxide of manganese, the following:—Distillation of the ore with hydrochloric acid, collection of the chlorine gas given off in an aqueous solution of iodide of potassium, and estimation of the iodine set free by means of a 1-10th solution of hyposulphite of soda; this process is really the same as that which the manufacturer employs for making chlorine; any magnetic iron ore present will become oxidised in both these processes (the testing just described and the chlorine making on the large scale), and an examination for magnetic oxide of iron is rendered unnecessary, while the available manganese for the production of chlorine only is estimated.—*Zeitschrift für Analyt. Chemie.*

ON THE ABSORPTIVE PROPERTIES OF SILICA,

AND ITS DIRECT HYDRATION BY CONTACT WITH WATER.

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

In No. 157 of the Chemical News, I communicated the fact that silica is hydrated and dissolved by aqueous solution of ammonia. Evidence in favour of this being given in a recent number of the same journal, together with particulars as to the amount of this solubility, I thought it desirable to ascertain whether ammonia is absolutely necessary to ensure this, the first of these reactions, the hydration of the silica; it occurred to me that water might effect it of itself—the action of ammonia, in this instance, being confined to bringing the silica, thus hydrated, into solution.

The following experiments tend to show this assumption to be correct:—

Rock-crystal, finely pulverised in an agate mortar, then agitated with water, did not completely subside, even after the lapse of some days; the water remained turbid, like clay-water, and, like it, is soon clarified by the addition of an acid or a neutral salt.

The effects of such additions would, I conceive, rather retard the precipitation of the silica, by increasing the gravity of the fluid, were it not that combination between the silica and the water had commenced—were it not, also, for an affinity of this substance for water under these conditions—feeble, no doubt, as to intensity, but insatiable as to quantity.

There appears to be one weak point in the evidence here tendered—viz., that agate (the substance of the mor-

tar used) is not pure silica; still, it is so nearly pure, that, upon the whole, it is, I think, quite safe to leave this matter out of further consideration.

In reference to other absorptive properties of silica, I find that massive quartz, rock-crystal, and silica, prepared for estimation in the usual way, take sesquioxide of iron from solution of its acetate, but not from the chloride.

Prepared silica, especially, manifests this property, if ignited at a low temperature; and, besides, takes oxides of chromium and copper from their acetates, and removes certain organic matters from their aqueous solutions. These reactions are more apparent in this case, because the silica is in a finely divided state, *chemically* pulverised in fact.

These reactions show silica to be a feeble mordant, and I think they have an intimate relation to what is termed the physico-mechanical absorption of soils, &c., since we thus see that one of the main constituents of rocks and soils, supposed to be at once the most inert and the most insoluble in an ordinary way, are capable of chemically absorbing certain substances to an extent proportionate to that of the surfaces exposed; such surfaces, even those of rock-crystal itself, are certain to be in a hydrous, in fact in a pulpy state, whenever water has had prolonged contact with them. It follows, therefore, if a substance, which has hitherto been held to be so inert and so unassailable, in these respects, as quartz, is thus actually affected in this manner, we may be certain that the great bulk of our soils, and our more porous rocks, have been affected by water and saline substances in a similar manner;—we may be quite certain that the surfaces of every siliceous stone, and of every grain of siliceous sand in our soils, is hydrated, and, by so far, advanced to the possession of what is termed the physico-mechanical absorptive power for plant-food.

It only remains for me to state that the reactions here described tend to resolve the so-called "*physico-mechanical* absorption of soils for plant food," into a simply chemical one, or at least, as much a chemical one as are any of those undisputably recognised as such.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 3rd, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—D. Howard, J. Muter, C. W. Siemens, F.R.S.

On opening this first meeting in the new session, the President alluded, in a few earnest words, to the loss the Society had recently sustained through the death of two of the most distinguished of its members.

The following papers were read:—

"*On the Production of the Sulphates of the Alcohol Radicles from the Nitrates by the Action of Sulphurous Acid*," by E. T. CHAPMAN.

When sulphurous acid gas is passed into nitrate of amyl it is rapidly absorbed. The nitrate changes in colour from yellow to green, from green to blue; it then begins to effervesce, and at the same time becomes hot and boils violently. Nitric oxide is evolved in abundance, and a yellow liquid product remains. This liquid cannot be distilled without decomposition. It contains no nitrogen. When an attempt is made to distil it along with water, the oily liquid found in the distillate consists principally of amylic alcohol. When the liquid is distilled *per se*, it blackens, gives off sulphurous acid, and yields a complex distillate, which contains, amongst other things, valerianate of amyl. This circumstance stood in the way of any attempt to obtain an insight into the nature of this reaction. Mr. Chapman resolved, therefore, to attack the question quantitatively. With this object, he determined the nature and amount of the gas evolved, by the action of excess of sulphurous acid on a known weight of the nitrate. The result proved that the gas evolved consisted of pure nitric oxide, and that the whole of the nitrogen present in the nitrite escaped in this form. The amount of sulphurous acid necessary to decompose a given quantity of nitrite, was also determined by observing the quantity of sulphurous acid which disappeared when an excess of sulphurous acid acted on a known quantity of nitrite. It was thus ascertained with sufficient accuracy that one atom of sulphurous acid acted upon two atoms of nitrite of amyl, and liberated two atoms of nitric oxide. Lastly, the alteration of weight which nitrite of amyl undergoes by the reaction was determined. The result confirmed the supposition that the reaction consisted in the replacement of two atoms of nitric oxide by one of sulphurous acid.

$$\left.\begin{matrix}C_5H_{11}ONO\\C_5H_{11}ONO\end{matrix}\right\} SO_2 = \left.\begin{matrix}C_5H_{11}\\C_5H_{11}\end{matrix}\right\} SO_4 + 2NO$$

The resulting liquid compound had, therefore, the composition of neutral sulphate of amyl. It readily breaks up into amylic alcohol and sulphuric acid by boiling with water, and by long standing even with cold water; treated with strong hydriodic acid it yields sulphuretted hydrogen, water, iodine, and amylic iodide; potassic bichromate and sulphuric acid cause it to yield valerianic acid. It is to be observed that it is necessary gently to warm the retort in which the nitrite is exposed to the action of a stream of dry sulphurous acid; if this is not done, the SO_2 is absorbed for some time without any reaction occurring, but when the reaction does start it is with almost explosive violence, whereas if gentle heating has been applied from the beginning the reaction starts at once and goes on regularly. It is also desirable to pass through the apparatus carbonic acid or hydrogen, before the SO_2 has been passed into the nitrite, and to do this also afterwards for the purpose of excluding air, the oxygen of which would unite with the NO, and the SO_2 would then be expelled.

Sulphurous acid and butylic nitrate react upon one another in a manner analogous to that of SO_2 or amylic nitrite, but the resulting product is even more unstable.

Sulphurous acid and nitrite of ethyl do not readily act upon each other, at least not at the common temperature.

Mr. Chapman then proceeded to the theoretical considerations which are suggested by the above facts. Are these compounds properly speaking sulphates of alcohol radicles, or only isomeric bodies with them? The reaction of the amyl compound with water is very different from that of sulphate of ethyl under similar circumstances; it does not, when boiled with water, form an acid analogous to isethionic acid, but splits up into sulphuric acid and amylic alcohol. This would suggest a different linking of the molecules; most probably in the common amylic sulphate the two organic radicles are linked to oxygen directly, and by oxygen to sulphur; in the amyl compound obtained from the nitrite one of the radicles is attached directly to sulphur, and the other indirectly through the oxygen.

Mr. Chapman then described the apparatus by which the nature of the reaction of sulphurous acid on amylic nitrite has been determined. The evolved nitric oxide was transformed into nitric acid and this treated with barytic carbonate.

In the discussion following this paper, Dr. Debus and Mr. Harcourt expressed their apprehension that along with the barytic nitrate also some barytic nitrite may have been formed. Mr. Chapman replied that he had taken great care to ensure the complete transformation into nitric acid; that to this end he had passed great quantities of oxygen into the collecting cylinder, left the mixture standing for twenty-four hours over the water in

the cylinder, and lastly applied gentle heat to it. As for the possibility of the water acting as a base and reducing the formed nitrous acid, there was the counteracting presence of SO_2 which had passed unabsorbed through the amylic nitrite into the collecting cylinder, and part of which must have been oxidised to sulphuric acid. Regarding Mr. Chapman's theoretical views of the union of SO_3 and $\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O$, the President thought that it is the same as that of SO_3 with H_2O, that the two C_2H_5 are linked to SO_3 by the oxygen just like the two H are in hydric sulphate.

Mr. Vacher read a paper by Mr. Elliott, on the "*Determination of Sulphur in Cast-Iron.*"

This determination consists in the liberation of the sulphur in the form of sulphuretted hydrogen, absorption of the latter by solution of soda, and estimation of the H_2S in the acidified soda solution by means of a standard solution of iodine. In the course of his experiments Mr. Elliott noticed that a portion of the iron was not attacked by HCl, and that this insoluble residue yielded on fusing with pure caustic soda (prepared from sodium), sodic sulphate. From this Mr. Elliott draws the conclusion that cast-iron contains sulphuric acid as well as sulphur. In somewhat similar manner the presence of phosphoric acid in cast-iron was ascertained.

Dr. Debus doubted the probability of the occurrence of sulphuric acid in iron which had once been in a molten state.

Mr. Church remarked that he had noticed by dissolving natural pyrites in HCl that very often an insoluble sulphide and phosphide remained. At the same time, he considered the fusion of these residues with caustic alkalies as a sure means of converting the sulphur and the phosphor into the respective acids, the alkalies being, under such circumstances, very powerful oxidising agents.

Mr. Harcourt expressed his concurrence with Mr. Church's remarks about the oxidising *rôle* played in this case by caustic soda.

Mr. Vacher did not wish to support Mr. Elliott's views about the presence of sulphuric acid in cast-iron; but there was the fact of one portion of the sulphur not being liberated by the HCl, and this tends to the conclusion that cast-iron contains sulphur in yet another form, as in that of the ordinary sulphide.

"*On the Composition of Hyposulphites*," by E. A. Letts.

Though the salts of the hyposulphurous acid have been comparatively well studied, much difference exists as to their chemical constitution. Rose states that an atom of water is retained by all the hyposulphites, and is essential to their composition. On the other hand, Pope and other chemists maintain that most, if not all the hyposulphites, can be obtained in the anhydrous condition. Mr. Letts undertook some experiments to ascertain whether hydrogen was to be regarded as an essential constituent of the hyposulphites. The salts submitted to investigation were those of sodium, barium, lead, strontium, magnesium, nickel, and cobalt. The sodium salt lost all its water readily by drying *in vacuo* over sulphuric acid. The barium salt gives off its water by drying at 100° C. The plumbic hyposulphite, prepared by adding a solution of lead acetate to one of sodic hyposulphite, crystallises out from the mother liquors without any water at all. This, then, is a case demonstrating beyond doubt that hydrogen is *not* needed to complete the chemical constitution of a hyposulphite. The strontium salt, retained even after drying at 200° C., half a molecule of water. The magnesium salt crystallising with six atoms of water looses, by 100° C., three of them; but an attempt to expel more water causes the decomposition of this salt. The nickel hyposulphite, the crystals of which have also six H_2O, cannot afford to part with any of it without undergoing decomposition. The cobaltic hyposulphite is even more unstable than the former salt.

The President observed that the contents of the last read paper set at rest the doubts which hitherto existed as to the constitution of the hyposulphites, and showed that the water which they ordinarily contain, is not essential for their chemical existence.

The Society then adjourned till November 17th.

CORRESPONDENCE.

NEW ELECTRO-DYNAMIC LAW.

To the Editor of the Chemical News.

Sir,—In the letter you were good enough to publish last week, giving a new electro-dynamic law, by accident the definitions of $r(w)$, $h(w)$, R, and r were omitted; namely:—

$r(w)$ = resistance of wire.

$h(w)$ = heat developed in wire.

R = resistance of battery.

r = resistance of rest of circuit.—I am, &c.,

H. Highton, M.A.

Putney, November 5, 1870.

PRESERVATION OF STONE.

To the Editor of the Chemical News.

Sir,—I am really sorry that my friend Mr. Spiller should imagine himself aggrieved by the existence and the success of the "Combined Process" for preserving stone. When he can prove that he was the first to employ solutions of an acid phosphate of calcium, or of an alkaline earth, or of a supersilicated alkaline silicate, separately or successively, for the purpose of preserving stone, I shall be ready to admit his right of complaint. A reference to the report of the Chemical Sub-Committee on the "Decay of the Stone of the New Palace of Westminster," printed in a Blue-Book, August, 1861, will show that phosphoric acid and superphosphate of lime had been proposed previously to that date for the use in question; this was also the case with solutions of the alkaline earths. As to the solution of silica, we owe that, Sir, to your suggestion; but unmixed with an alkaline silicate, I have failed to to make it penetrate any stone containing much calcareous matter.

On the whole, then, I argue that Mr. Spiller cannot claim novelty of application with respect to either of the solutions he is said to use, and that I had as good a right to adopt them as he had. But if Mr. Spiller really employs (see his letter in this week's Chemical News) a solution of "superphosphate of lime *mixed* with a little baryta," I admit at once the complete novelty of such a preparation.

I should, however, much like to know how he prevents these "*incompatibles*" from precipitating one another. It would be very interesting to see mono-calcic phosphate and barium hydrate co-existing in Mr. Spiller's solution.—I am, &c.,

A. H. Church.

Royal Agricultural College, Cirencester, November 5th, 1870.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the second B.Sc. examination:—*First Division.*—John Ambrose Fleming, University College; Thomas Hick, B.A., private study. *Second Division.*—Edward Bibbins Aveling, University College; Frank Clowes, College of Chemistry and private study; William Turner Thistleton Dyer, private study; John Anderson Hartley, B.A., University College and private

study; Henry Newell Martin, First M.B., Christ's College, Cambridge, and University College, London; Thomas Firth Moorhouse, private study; Robert Davies Roberts, University College; Robert Routledge, Owen's College; Frank Salter, University College.

Phosphate of Lime as a Mordant.—Dr. Reimann.—A rather thick syrupy solution of phosphate of lime (bone-ash) in hydrochloric acid having been recently recommended as a mordant to be used after a previous sumacking of the goods, the author states that, according to his researches, the phosphate of lime solution is altogether superfluous, since a sumacking with 4 lbs. of sumac to 20 lbs. of cotton is of itself a sufficient mordanting to fix aniline colours excellently. The application of the phosphate of lime solution as a mordant for cochineal colours upon cotton the author also considers as quite useless.

Solution of Water Glass.—Dr. Flückiger.—This solution is precipitated by a solution of nitrate of soda, and the following curious phenomenon is exhibited; when a solution of silicate of soda of 1·392 sp. gr. is precipitated with a solution of one part of nitrate of soda in one of water the silica is immediately separated, but if the nitrate is dissolved into two parts of water, and if equal parts of both liquids are mixed, no precipitate ensues until the mixture is heated to 54°, when silica separates in a gelatinous state so as to cause nearly the solidification of the mass. If this experiment is made in a small flask and the vessel suddenly cooled again, either to the ordinary temperature or even below 0°, the silica is suddenly dissolved again; this experiment may be repeated any number of times.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Sitzungsberichte der Königlich Bayerische Akademie der Wissenschaften zu München, Vol. i., No. 1, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and allied sciences:—

Comparator for the Indication of the Toise and the Meter, and also for the Determination of the Absolute Longitudinal Expansion of Rods.—Dr. von Steinheil.—This paper, illustrated by engravings, contains the description of an instrument (comparator) devised by the author for detecting the absolute longitudinal expansion of metallic rods employed for the construction of measures of length.

Changes which the Colours of some Blossoms and Flowers Undergo when Exposed to Ammonia Gas.—Dr. Vogel.—The author relates, at great length, a series of experiments extended over no less than eighty-six species and varieties of flowers, and made with the view to learn how the colours thereof are affected by the action of ammonia gas, the flowers being exposed to that gas by being placed under a bell-jar filled with the gas, and left in that condition for from a quarter of an hour to two, or even twelve, hours. Among the general results obtained by the author, we notice that he found marked difference to exist between the action of the gas upon flowers, the colouring matter of which is fixed in small granules, and that which is present in solution; the former is far less changed than the latter. Among the eighty-six kinds submitted to research, twelve exhibited no change whatever; of these, seven were yellow, and five deep violet-coloured. Deep violet-coloured flowers are not at all affected, and some blue colours also stand the action of the gas for a time very well. The alteration produced by the gas is, in most cases, very akin to that called forth by the fading away of the flowers. The yellow colouring matter of the *Lotus corniculatus* exhibits a great stability, since it withstands the action of ammonia gas for twelve hours without change. On becoming dry, this colouring matter becomes bright green.

Quantity of Water Evaporated by an Oak-Tree during the entire period of its Growth.—F. Pfaff.—This lengthy treatise contains the results of phuto-physiological experiments made with the view to ascertain the quantity of water evaporated during the entire period of vegetation of an oak-tree, as deduced from very minutely and accurately executed experiments, and in order to illustrate the effects of trees and forests as affecting the rainfall. The essay is accompanied by lengthy tabulated forms containing a series of figures.

On Rabdionite, a New Mineral Species, and on an Asbolan which contains Lithia.—F. von Kobell.—Rabdionite is a mineral exhibiting a dull black colour; it becomes metallic-like when rubbed; is very soft; its powder is deep brown-coloured. The sp. gr. of the mineral is 2·80; it fuses in the blowpipe flame, yielding a steel-blue coloured globule which acts upon the magnetic needle (the mineral does not do so before being fused). On being heated in a small flask or test-tube, water is given off. The mineral is readily soluble in hydrochloric acid, chlorine being evolved, but hardly soluble in nitric acid. Analysis, in 100 parts, gave—Peroxide of iron, 45·00; peroxide of manganese, 13·0; alumina, 1·40; oxide of copper, 14·0; protoxide of manganese, 7·61; oxide of cobalt, 5·10; water, 13·5;—total, 99·61. The name rabdionite is derived from the greek word *rabdion*, a small rod, because the mineral occurs in a shape resembling this. The mineral was obtained from the Nischne-Tagilsk mines, on the Ural (Russia). The author briefly mentions some researches instituted by him with a mineral which was stated to be asbolan, but differs in composition from a mineral of the same name analysed by Dr. Rammelsberg, inasmuch as the mineral investigated by the author contained lithia in very small quantity, however, and, besides, 54 per cent of peroxide of manganese, 4 of oxide of cobalt, 0·61 of oxide of copper, 13·4 of water, and 23 per cent of alumina.

Vol. I., No. 2, 1870.

This number contains the following original papers and memoirs relating to physico-chemical sciences:—

Researches on Electrical Discharge.—Dr. W. von Bezold.—This paper has been given in an enlarged and more complete form in another periodical, from which we have briefly abstracted it (see CHEMICAL NEWS, vol. xxii., p. 227).

On the Riesvulkan, and on Volcanic Phenomena in the Rieskessel.—Prof. Gümbel.—This lengthy memoir contains the detailed account of a geognostic and mineralogical investigation of a mountain belonging to the Swabian Jura chain.

Vol. i., No. 3, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

On Lüneburgite.—C. Nöllner.—The author states that, a boring having been made with the view to reach deposits of salt in the neighbourhood of Harburg (Prussia), a new mineral was found, to which the name lüneburgite was given. The composition of that mineral, in 100 parts, is—Magnesia, 16·75; water, 3·78; phosphoric acid, 29·83—this portion forming a separate salt, but combined in nature with the following constituents:—Magnesia, 8·35; boracic acid, 14·72; water, 26·17. Formula of lüneburgite—

$$[(2MgO,HO)PO_4+MgOBO_3]+7\dot{H}O.$$

On Gümbellite.—Dr. von Kobell.—The substance alluded to is a new mineral, named after its discoverer, M. Gümbel. The mineral occurs in thin layers on thouschiefer. The colour is whitish green; melts before blowpipe-flame with some difficulty, forming a porcelain-like mass. Heated in a flask or test-tube, water is given off; insoluble in hydrochloric and sulphuric acids. It consists, in 100 parts, of—Silica, 50·52; alumina, 31·04; peroxide of iron, 3·0; magnesia, 1·88; potassa, 3·18; water, 7·0; matter undecomposable by fluorhydric acid, 1·46;—total, 98·08.

Vol. I., No. 4, 1870.

The following original papers relating to chemistry and collateral sciences are found in this number:—

Luminosity of the Water Hammer.—Prof. Lommel.—This memoir contains the account of a series of experiments made with the view to ascertain whether the instrument known as the water hammer (in this instance constructed of glass tubes of from 15 to 23 centimetres' length, by from 10 to 15 millimetres' width, and provided on one end with a bulb of about 4 centimetres' diameter, the tube being partly filled with pure water freed from air by long-continued boiling) would, when electrified as Geissler's tubes, produce phenomena similar to the latter when electrified. The author found that the water hammer acts in a very similar manner as do the Leyden jars, which are connected with the conductors of electric machines (*influenz maschine*) for the purpose of obtaining stronger sparks; moreover, the tubes alluded to exhibited brilliant luminous phenomena.

Vol. II., No. 1, 1870.

This number contains the following papers relating to physico-chemical sciences:—

Crystal Water.—Dr. F. von Kobell.—This very lengthy treatise sets forth the following facts:—Water of crystallisation is an absolute requisite necessary to the very existence of a chemical species. This water therefore belongs to the true chemical constitution of a body, and is not an appendix to its physical properties, as is the case with hygroscopic water. When the water necessary for the existence of any compound is termed water of constitution, all water of crystallisation has to be so named, because it is absolutely necessary to form the specific compound, which is altered and changed in its character as soon as the water is eliminated.

Annalen der Physik und Chemie, von Poggendorff, No. 9, 1870.

This number contains the following original papers:—

Calorimetric Researches.—R. Bunsen.—This lengthy memoir, illustrated by engravings, is divided into the following sections:—The ice calorimeter; estimation of specific heats. The contents of this memoir more strictly belong to the domain of algebraical than experimental natural philosophy. The paper abounds with formulæ and tabulated results.

Relation Existing between the Crystalline Form of Bodies and the Chemical Constitution of some Organic Compounds.—P. Groth.—The author states that his object in writing this paper has chiefly been the investigation of the relation which exists between the crystalline form of a chemical compound, and the change that form undergoes when, for one or more of the hydrogen atoms of the compound, are substituted other groups of atoms. The author illustrates this by several instances—as, for instance, benzol, C_6H_6, which crystallises in the rhombic shape, while its first hydroxyl-derivative, phenol, assumes the same shape. The contents of the paper are, however, purely crystallographical, and, therefore, not suited for further abstraction.

Experimental and Theoretical Researches on the Equilibrium Figures Exhibited by a Fluid Mass not endowed with Gravity.—J. Plateau.—Eighth paper on this subject.

Absorption of Light.—P. Glan.—A mathematico-physical essay illustrated with engravings.

Appendix to a Paper on "Researches concerning the Behaviour of Vapours as regards the Laws of Mariotte and Gay Lussac.—Dr. H. Herwig.—This paper is chiefly a collection of tabulated results of experiments.

Analogy Existing between some of the Principal Axioms of Photometry and the Doctrine of Attraction.—W. Bezold.—An algebraical essay.

Luminosity of Phosphorus.—W. Müller.—The contents of this paper are an extended report of the author's experiments on this subject, already quoted, in its essential details, from another periodical (see CHEMICAL NEWS, vol. xxi., p. 190).

Peroxides of Metals which can be Obtained by Electrolysis.—W. Wernicke.—This lengthy essay treats on lead, manganese, bismuth, cobalt, and nickel. The author's results of experiments may be summarised as follows:—The peroxides of metals separated from alkaline or neutral solutions by means of electrolysis are hydrates, composed according to the formulæ RO,H_2O or $R_2O_3,2H_2O$. The composition and specific gravity of the substances investigated are—Hydrated peroxide of lead, $PbO_2,H_2O=6{\cdot}267$; hydrated peroxide of manganese, $MnO_2,H_2O=2{\cdot}564-2{\cdot}596$; hydrated peroxide of bismuth, $BiO_2,H_2O=5{\cdot}571$; hydrated peroxide of cobalt, $C_2O_3,2H_2O=2{\cdot}483$; hydrated peroxide of nickel, $Ni_2O_3,2H_2O=2{\cdot}744$. These substances exhibit, in thin layers, most magnificent interference colours; and, for the technical purposes of metallo-chromy, the colours exhibited by the hydrated peroxide of cobalt will be valuable, on account of being readily prepared and permanent. The compounds alluded to were only produced by very weak electric currents; stronger currents produce other compounds containing less oxygen.

Mechanical Law Applicable to Calorics.—R. Clausius.—An algebraical essay.

Spectra Exhibited by Negative Electrodes and by Geissler Tubes which have been Used for a Long Period of Time.—Dr. E. Reitlinger and M. Kuhn.—An extensive and concisely-written essay, not suited for any useful abstraction.

Changes Produced in the Brown Coal (Lignite) of the Meissner by Coming into Contact with Basalt.—Dr. A. von Lasaulx.—The locality designated as the Meissner is a mountain situated in the Prussian province of Hessen. The paper is chiefly written with the view to prove that the changes which the lignite has undergone by coming into contact with basalt does not prove the igneous origin of the latter. The paper contains several analyses, among which are the following (all substances dried at 100°):—Anthracite (sp. gr., 1·412).—In 100 parts: Carbon, 80·40; hydrogen, 3·30; sulphur, oxygen, and nitrogen, together, 5·67; bituminous matter, 0·73; ash, 9·90;—total, 100·0. A material named *stangen kohle*, that is, a coaly matter in the shape of rods (sp. gr., 1·397).—In 100 parts: Carbon, 78·14; hydrogen, 3·73; sulphur, oxygen, and nitrogen, together, 4·03; bituminous matter, 0·83; ash, 13·27;—total, 100·0. Deep black-coloured coaly matter (sp. gr., 1·286).—In 100 parts: Carbon, 62·20; hydrogen, 5·28; sulphur, oxygen, and nitrogen, together, 22·75; ash, 9·77;—total, 100·0 (bituminous matter in this coal was 1·5 per cent, and it was found to be partly soluble in caustic potassa, which is not the case with the other two samples). Compact brownish black-coloured lignite (sp. gr., 1·201).—In 100 parts: Carbon, 59·92; hydrogen, 5·66; sulphur, nitrogen, and oxygen, 26·12; ash, 8·30;—total, 100·0 (contains a large proportion of bituminous matter, and is in a great measure soluble in caustic potassa solution). In order to investigate the effect which a fused mass, as basalt has sometimes been supposed to be, would have upon this lignite, a considerable quantity was exposed to the action of molten blast-furnace slags, and the pieces so exposed analysed, the result being (sp. gr., 1·363), in 100 parts—Carbon, 80·36; hydrogen, 3·04; sulphur, nitrogen, and oxygen, 1·20; ash, 15·40. The lignite was exposed to the action of the slags in fire-clay crucibles and under a cover of fire-clay.

Analysis of Silicates.—E. Ludwig.—This paper treats on the analysis of a felspar from Närödal (Norway), which, having been analysed by the author, as well as by Dr. G. von Rath and Professor C. Rammelsberg, yielded, to each, results which exhibit rather great discrepancies in the quantity of silica and alumina obtained by these authors, varying, for silica, from 51·78 to 48·94 per cent, and for alumina from 33·36 to 30·77 per cent. The author's paper is a lengthy essay on the different methods in use for estimating silica and alumina when present in complex minerals, but, unfortunately, the bulk of the essay consists of quotations of results of test analyses, and is, therefore, not well suited for further quotation.

Absorption-Spectrum of Fluid Hyponitric Acid.—A. Kundt.

Observations on Dr. Boltzmann's Paper "On the Force Exerted by Moving Masses of a Gas."—Dr. Kurz.

Polytechnisches Journal von Dingler, first number for October, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

The Tallow-Melting Industry.—Dr. H. Vohl.—This paper, illustrated by engravings, treats on the best methods to prevent the complaints, often, and not unreasonably, made, about the smell and nuisance arising from the melting of tallow. The author describes at length a contrivance whereby the melting of tallow may be conducted without giving rise to any complaints. Unless we were to reproduce the engraving, absolutely required to understand the arrangement, we could not enter into further details on this subject.

Description of the Adalbert Ironworks at Kladno (Bohemia).—J. Zeman.—This paper, illustrated by several engravings, is the first portion of a detailed description of an ironwork which, however interesting it may be for the Continent, is surpassed, in extent and perfection of arrangement, by several similar works in the United Kingdom.

Desilvering Lead by means of Zinc.—C. M. Balling.—A lengthy treatise, illustrated by several engravings, containing a detailed account of the process alluded to as practically executed in different countries.

NOTES AND QUERIES.

Estimating Tartaric and Citric Acids.—(Reply to A. J. M. Edger).—You will find the information you require, too lengthy to be here printed, in Richardson and Watts's "Chemical Technology," vol. i., part 5, pp. 168 and following and 178 and following.

Manufacture of Anthracene.—I have been requested to enquire whether there is in England anyone manufacturing anthracene out of *raw petroleum* or the *residue of petroleum distillation*. I understand that anthracene is usually made from asphaltum both in England and abroad, but that the other process, mentioned above, has been introduced for some time.—J. BERNAYS.

Decolourising Property of Animal Charcoal.—Will any correspondent be good enough to inform me where the best explanation that has yet been given of the peculiar decolourising and other properties of animal charcoal is to be found. The accepted theory in all the works I have consulted appears to be that the action is purely mechanical, and due to the surface of the numerous pores. The doubt expressed by most of the authors, induces me to ask this question.—A STUDENT.

Phosphate of Lime.—(Reply to W. Tate.)—On referring to Gmelin's "Chemistry," translated by Watts, you will find the equivalent of $3CaO,cPO_4$ given as 155·4, while cPO_4 is there stated to be 71·4. At page 192 and following of vol. iii. of the work alluded to, you will find the theory of Berzelius alluded to based upon his experiments as regards the salt; the equivalent of $2CaO,PO_5$ is stated to be 127·4, and the equivalent of $2CaO,PO_5,4HO=163{\cdot}4$. In commercial analyses, the figures quoted by you are usually taken as the equivalent of triphosphate.

Dyeing Queries.—Can any of your readers kindly give me a little information on the following subject:—I have a friend who is manufacturing cloths of enclosed kind, and he has set up a steam-box of his own, so as to tip or print his own; and I have a small works of my own, where I make extract of logwood, &c.; and I wish you to give me a formula for a good black colour, and one for a dark claret (or chocolate, as some call it)—but I want the colours to be of a good lustre after being steamed; and for full depth of colour the fine pieces are tipped with a brush, then put into a large steam-box for an hour at a pressure of 12 lbs. to the square inch; they are then taken out, all the colour washed out, and dried. Many of them are done twice over.—A. SYKES.

MEETINGS FOR THE WEEK.

MONDAY, 14th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action."
TUESDAY, 15th.—Geographical, 8.30.
THURSDAY, 17th.—London Institution, 7.30. Dr. W. H. Stone, M.A., F.R.C.P., "On the Acoustics of the Orchestra; Wind Instruments."
——— Chemical, 8. Prof. N. Story Maskelyne and Dr. Walter Flight, "Mineralogical Notices."

TO CORRESPONDENTS.

A. Whitelaw.—We regret that the report of the meeting arrived too late for insertion this week.

J. Bowing.—The query is inserted with pleasure.

F. M. Jennings.—Received with thanks. The Hungarian opals will be carefully examined. They are good specimens.

THE CHEMICAL NEWS.

Vol. XXII. No. 573.

EVIDENCE CONCERNING THE

GERM THEORY OF FERMENTATION

AFFORDED BY THE ACTION OF CERTAIN SUBSTANCES WHEN SUSPENDED IN THE AIR.

By ARTHUR ERNEST SANSOM, M.D.

In the controversy respecting the origin of life, which has recently occupied much of the time of scientific men, and has called forth much warmth of advocacy on either side, great stress has been laid upon the evidence afforded by the action of heat as a means of destroying vital manifestations. It has been urged as impossible that any living matter can, after subjection to a temperature of more than 307° F., continue to manifest any signs of vitality. Some objectors have demurred to the conclusion that *all* the possible particles in the fluids employed were by the conditions subject to this high temperature; others, while accepting the premisses, have objected to the conclusion. It is well known that living matter has powers of persistence and resistance which no *primâ facie* considerations would suggest.

It is admited that living matter can be exposed to sudden extremes, from freezing to boiling, without losing the germinating faculty.* It can scarcely be wondered at, therefore, that some persons hesitate to adopt the alternative conclusion that living things can be generated "spontaneously"—*i.e.*, from dead matter and ordinary physical forces. It may, at least, be urged that the conclusions obtained from the evidence of heat should be tested by the results of the employment of other agents of vital destruction.

In the late controversy, such influences seem to have been ignored; but, among these, many useful lessons may be learnt by a consideration of the destructive influences of chemical and of poisonous agents. It was known, from very early ages, that certain substances added to matters undergoing fermentation or putrefaction† put a stop to these processes. The process of embalming, for the prevention of putrefaction of the human body, is an example which dates from the greatest antiquity. Emanations from putrid material have been always looked on as sources of danger to health, and various applications have been made to putrefying materials with the object of arresting putrefaction. Sir John Pringle and Dr. Macbride, in the last century, classified such substances as arrested putrid emanations under the title of Antiseptics; these observers, moreover, performed many experiments with regard to them, and endeavoured to ascertain their relative values. There have been various theories advanced to account for the mode of operation of these various bodies in restraining putrefactive changes, and usually their action has been considered, in some sort, a chemical one—they either oxidise, deoxidise, or chemically unite with the putrescible material. But we should imagine, if a chemical agent arrested putrefaction or fermentation in virtue of its chemical powers, there should be some sort of quantitative relation between its potential activity and the constituents of the substance itself. At least, we should imagine that, in the one case, it should be present in sufficient proportion to produce some appreciable chemical change upon the bulk of the nitrogenous substance, in the case of putrefaction, or the ferment or the fermentescible substance in the case of fermentation. But the facts are, that substances present in such feeble amounts as to be incapable of any manifest action upon the organic material, are, nevertheless, competent to arrest all the phenomena of putrefactive or fermentive decomposition.

Let us turn to the theory which proposes to explain the phenomena, on the supposition that they are produced by the acts of life of organised particles.

We see, by very obvious data, that there is an analogy which cannot fail to be remarked between the phenomena of the two processes and the conditions which we know to be favourable to vital organisms—air, light, warmth, moisture—these are the conditions most favourable to the changes. Conversely, circumstances antagonistic to life are unfavourable to the changes; such are an excess of heat or a very low temperature, dryness, physical injury (triturating yeast in a mortar spoils it for effecting fermentation). Gases which do not support life stop the phenomena of putrefaction and fermentation: such are hydrogen, nitrogen, carbonic acid. Furthermore, not only there is a definite relation between the stage of growth of the yeast fungus and its power of exciting fermentation, but, in the words of Professor Miller, "everything that destroys the vitality of these organised bodies destroys their power of exciting fermentation."

Also, with regard to mildew formation. As M. Béchamp showed, whilst mildew was developed on every occasion when air acted on putrescible material, and no substance fatal to organisms was present, no mildew was observed when any substance which killed germs was present. But here Professor Hallier steps in and shows that many saline solutions which might, *à priori*, be deemed likely to exert toxic influences nevertheless—some to great extent others slightly—permit the growth and development of fungi. Acetic acid, when dilute, permits growth, and its salts afford admirable pabula for penicillium growths. The same is true of oxalic acid and the oxalates. Vegetating fibres are also found in the alkaline and earthy chlorides, and in boiled sea-water. The phosphates, also, are very favourable for vegetation. Tannin is a good pabulum; and cyanides readily permit growth. The mineral acids, only when very dilute, permit any vegetation; but their salts often allow growth of penicillium, &c.

On the other hand, alcohol, benzol, and carbolic acid are powerful poisons to fermentation-cells and mildew formations.

Carbolic acid acts *solely* by killing the organised bodies which are the intermediate agents between organic material on the one hand, and the inorganic ultimate products of decomposition on the other. What bearing does this conclusion have on the controversy concerning the origin of life? While it puts aside all notions of intermediate chemical changes as favouring the spontaneous evolution of organisms, the objection may yet hold that the *initial* changes may yet be heterogenic, though the carbolic acid exerts its toxic power when once a molecule has acquired vitality. To obtain some evidence on this question as well as to endeavour to fix the action of carbolic acid in its relation with other media, the following experiments have been performed by the author:—

Expt. 1.—Freshly made maceration of lean beef was kept in bottles, A, in contact with ordinary air; B, in air containing the vapour of carbolic acid. A showed usual signs of putrefaction; at the end of twelve days was of extreme fœtor, and presented upon its surface a dense film which, when examined by the microscope, disclosed myriads of microscopic organisms. B in its whole extent was clear and transparent, and possessed no odour save that of carbolic acid; the film instead of being made up

* "Les infiniment petits possèdent donc, pour la plupart, une résistance souvent surprenante au chaud et au froid. Une expérience de M. Pouchet montre même que certains d'entre eux peuvent supporter facilement des brusques changements de température, franchir un intervalle de plus de 100 degrés!"—*Pennetier, Origine de la Vie.*

† It should be premised that there are two theories concerning the nature of fermentation and putrefaction. According to the one, these processes are essentially chemical, and are the results of the actions of nitrogenous organic bodies undergoing molecular (catalytic) changes. According to the other, they are due to the acts of life of vitalised (fungoid) particles. For a statement of the arguments, the reader is referred to a paper which will appear in the next number of the *Quarterly Journal of Science.*

of a congeries of minute organisms, was a basis structure of an exceedingly delicate and perfectly transparent membrane. It entangled here and there a few aggregations of monads.

In this case no effort was made to destroy any possible germ in the meat infusion; only in one case the *air* contained a poisonous agent, and here a marked repression was exerted upon the appearance of forms of life and upon the process of putrefaction.

(To be continued).

EXPERIMENTS UPON SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By ARCHIBALD LIVERSIDGE,
Associate of the Royal School of Mines.

Review of Theories.

BEFORE drawing attention to the results furnished by my own experiments, it will, perhaps, not be out of place to pass in review the various theories which have been put forth in explanation of the action of nuclei upon supersaturated saline solutions. This I do because my experiments are supported by some and not by others of these theories. In 1809, Ziz, of Mayence,* came to the conclusion that a crystal of sodic sulphate was the best nucleus for a supersaturated solution of that salt.

Gay Lussac, in 1819, was of opinion that the sudden crystallisation of a supersaturated solution was due to a purely mechanical force, such as the agitation of the liquid within the containing vessel.† "La cause générale qui produit la sursaturation étant évidement la même pour chaque sel, il suffra d'observer cet effet dans ceux ou ils se montrent avec la plus d'intensité . . . . On ne peut assigner le terme auquel la sursaturation s'arrête: ce terme, dans chaque expérience est tout-à-fait accidental, il depend de la nature du vase, de son poli, de sa propriété conductrice, de l'agitation de l'air. . . . . Or, puis qu'on détermine la cristallisation dans cette dissolution sur-satureé de carbonate de soude par une légère agitation il faut que la sursaturation depende non de l'affinité, mais d'une force purement mecanique; car le mouvement ne peut par lui-même produire des effets chimiques."

Löwell,‡ in 1850, referred the phenomena exhibited by supersaturated solutions to some mysterious catalytic action of the air and other bodies.

In 1851, M. Goskynski‖ propounded the theory "that the upper layer of the liquid lost water by evaporation," by this means small crystals were set free, which formed centres of attraction from which crystallisation was propagated throughout the mass of the solution.

Gernez, in 1865, was convinced that nuclei acting upon solutions of sodic sulphate, consisted of particles of that salt which were disseminated throughout the atmosphere.

And respecting the presence of this salt in the air, he says:— "La presence de cette substance dans l'air n'a du reste bien d'extraordinaire, si l'on remarque que l'acide sulfureux et l'hydrogen sulfuré produit dans l'atmosphère se transforment facilement en acide sulfurique, et que le sel marin, provenant de l'eau de la mer, doit donner avec cet acide du sulfate de soude.§

In a later paper¶ he states that supersaturated solutions of alum, plumbic acetate, zincic sulphate, sodic hyposulphite, &c., can be kept fluid in open flasks for a longer time than sodic sulphate, on account of the less uniform diffusion of particles of those salts in the air.

M. Violette also arrived at about the same results, independently of Gernez.* He states that the activity of the nucleus is destroyed on exposure to a temperature of 33·5 or 34° C., it is dissolved or modified by water, Cl, Br, most gases, alcohol, ether, &c. He says that the air at all places and under all conditions does not equally contain these crystalline particles, just as M. Pasteur has shown is the case with organic germs. In some places the particles which provoke crystallisation are, at times, altogether absent.

M. Jeannel (*Comptes Rendus*, lxi., p. 412), attributed the crystallisation of supersaturated solutions to purely physical causes, and not to the action of a particle of the same salt.

M. Dubrunfaut† thought that the formation of the salt containing ten atoms of water was directly determined by the presence of such a crystal acting as a nucleus.

M. Lecoq de Boisdaudran‡ also experimented and wrote upon the phenomena presented by supersaturated saline solutions; he attributed nuclear properties to both the crystals of the normal sodic sulphate and to its isomorphs.

In 1868 a paper was communicated to the Royal Society, by Mr. Tomlinson, to show that the effects, attributed by earlier observers to various causes, depended solely upon want of chemical cleanness in the body which acted as a nucleus.

In this and subsequent papers the following definitions were given:—

"A nucleus is a body that has a stronger attraction for the gas, or the vapour, or the salt of a supersaturated solution than for the liquid that holds it in solution."

"Nuclei with certain limitations cease to be such when made chemically clean. A body is chemically clean the surface of which is entirely free from any substance foreign to its composition. Thus, oils and fatty bodies are chemically clean if chemically pure."

The limitations above referred to are two. "(1) Oils, fats, &c., when chemically clean, do not act as nuclei when in the mass, such as a lens or globule, but these oils, &c., whether clean or not, act powerfully as nuclei when in the form of thin films." The second limitation is connected with solutions of gases with which we have nothing to do here.‖

Again, "an active or non-catharised surface is one contaminated with a film of foreign matter, the filmy condition appearing to be necessary to secure that close adhesion which brings about the nuclear action."§

From the foregoing it appears that, in the main, three theories have been offered with respect to the action of upon supersaturated saline solutions.

I. That the crystallisation of a supersaturated solution is due to the entrance of a particle of the same salt.

II. That the crystallisation set up in such solutions is due to some unknown catalytic force.

III. Nuclei are fatty, oily, greasy, or other matters, in the state of thin films.

I will now proceed with the results furnished by my own experiments. It may not, perhaps, be superfluous for me to first give the method used in preparing the supersaturated solution of the salt.

Preparation of the Solution.

The re-crystallised sodic sulphate of commerce was dissolved in tap water; filtration was unnecessary, the salt as used being free from dirt; in some cases the solution was prepared in separate 2 oz. flasks or a greater quantity was dissolved in a large vessel, and then divided out into smaller flasks, each of which was then boiled up, previous to being set aside on a marble slab to cool

* Schweigger, *Journal für Chemie und Physik*, xv. For several of my references I am indebted to Mr. Tomlinson's paper in the *Phil. Trans.*, for 1868.
† *Ann. de Chemie et de Physique*, 2nd series, vol. xi. p. 303.
‡ *Ann. de Chemie et de Ph.*, 1850—1857.
‖ *Ibid*, vol. xxxvii., p. 156.
§ *Comptes Rendus*, vol. lx., p. 833.
¶ *Ibid*, vol. lxi., p. 849.

* *Comptes Rendus*, vol. lx., pp. 831 and 971; also *Memoir de la Société de Sciences de Lille*, 1860, 2nd series, vol. vii.; *Revue des Sociétés Savantes*, March 27, 1863.
† *Comptes Rendus*, April 19th, 1869.
‡ *Ann. de Ch. et de Ph.*, 4th series, No. xviii.
‖ *Proc. Royal Society*, No. 108, 1869; and CHEMICAL NEWS, August 19th, 1870.
§ CHEMICAL NEWS, August 26th, 1870, p. 98.

during the night. An excess of salt was always used so as to ensure perfect supersaturation, the quantity in excess being left at the bottom of the flask or thrown down, on boiling the solution, in the form of the analogous salt. While still boiling the flask was either plugged with cotton wool, or covered with a watch-glass, as suggested by Mr. Löwell, or preferably a small beaker was used as a cover.

A great drawback to the employment of cotton wool is that filaments of it adhere to the neck of the flask, and these, on inserting a body, such as a rod or crystal, get carried down at the same time, when they cause the solution to crystallise, and thus vitiate the experiment.

The proper preparation of the solution is, of course, a point of fundamental importance, therefore I again repeat that in every case, when the substance under trial did not act as a nucleus, before accepting the results of an experiment I was careful to prove the supersaturation of each individual solution by means of a dirty rod or other body; for, as Mr. Tomlinson has remarked, a solution which is supersaturated at a given temperature, may be merely saturated at a higher.

Are Nuclei Rendered Inactive by Washing in Water?

Ziz, Gernez, and Violette say yes, but Mr. Tomlinson has lately pointed out* that although wet nuclei often do not, yet occasionally they do, act after some time, it may be several hours. Since the publication of this I have repeated many of my experiments upon them,† and am glad to say that they confirm Mr. Tomlinson's experience.

Experiments made with Thin Films.

It has been already stated that I did not find thin films active as nuclei,‡ and, in support of that statement, I subjoin the following series of experiments:—

Expt.—A glass rod was purposely made greasy, and exposed for a short time to the flame of a spirit-lamp, but not long enough to burn off all the greasy film. After cooling, it was placed in a supersaturated solution of sodic sulphate, and was allowed to remain in for some hours, but it did not set up crystallisation. On withdrawal from the flask the rod was washed with clean cold water, when its surface was shown to be still greasy by the manner in which the water ran off in places and collected into beads in others. After washing the rod in caustic alkali, the water wetted its surface uniformly.

This experiment was repeated many times and with the like results in each instance.

Expt.—The interior of a flask was made greasy, the solution boiled up in it and then allowed to cool. *No effect.*

When cold the inside was shown to be still greasy by the non-adhesion of the solution to the surface of the flask. A cold supersaturated solution wets a clean glass surface uniformly in the same way as water.

As a proof that the finger of itself becomes unclean and generates a nuclear action, Mr. Tomlinson cites an experiment made with rotating camphor particles (see Chemical News, September 2nd, p. 110), with a view to determine, "how long the finger, being made chemically clean, would remain so. The finger was first thoroughly washed in a solution of soap, then in alcohol, and lastly under a stream of water, and so dipped into water, on the surface of which camphor fragments were briskly spinning. The finger was retained under the surface of the water, and slid along about an inch in length of the surface of the glass below the water. In less than two minutes the camphor fragments were brought to rest, and they did not recover their activity."

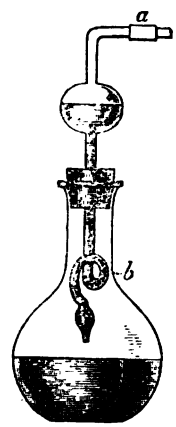
I readily admit that this secretion of the finger may render the surface of the water unclean, and that this uncleanness may arrest the motion of camphor particles, but I do not clearly see that because this secretion is effectual in arresting this motion, that it should also determine the crystallisation of a supersaturated solution of sodic sulphate. In the case of camphor the film may act by arresting the evaporation both from the surface of the water and from the camphor, for the latter in its movements would pick up a coating of oily matter, through which evaporation might not readily take place.

The next experiment was made in order to ascertain if the greasy film generated by the finger did become nuclear after some time.

Expt.—The finger was, first of all, made slightly greasy, then imperfectly wiped with a duster; it was now passed several times through the flame of a spirit-lamp, and finally inserted into a flask of solution; the flask was chosen with a neck of such a size that, when the last joint of the finger entered the liquid, the opening was completely stopped by the thicker part of the finger.

The flask was placed in water artificially reduced to a temperature of 40° F., and there kept for 10, 20, 30, and 35 minutes at a time, when the finger was withdrawn without crystallisation having taken place.

That the finger had not lost its film of grease was shown by the solution running off the nail every time it was



raised from the liquid, neither did the solution solidify when made to touch those parts of the flask upon which the finger had been pressed.

This experiment was repeated twelve times, and in *every* instance was the filmy matter of the finger inactive.

As it is sometimes found rather difficult to obtain iridescent films upon the surface of the supersaturated solution, the expedient of dissolving the oils and fatty bodies in ether was made use of. By this means a very small quantity of the fatty substance under trial was caused to cover a large area, for as the ether evaporated an excessively thin film of the less or non-volatile matter, as the case might be, remained behind upon the surface of the solution.

In order to permit the oil, fatty, or other body being conveyed to the solution without access of nuclei from extraneous sources, the contrivance figured above was employed, and the manipulation was as follows:—

The knot, *b*, was first rendered inactive by heating it in the lamp flame, the bulb was warmed, then the tube was inserted into the bottle containing the ethereal solution of oil, or other fluid; then as the air in the bulb cooled a small quantity was sucked up; this was then boiled both in the bulb and in the knot so as to destroy any nuclei which might be adhering to the bulb-tube or be contained by the fluid under trial; usually during the boiling the liquid inflamed and burnt at the aperture of the knot, but this offered no difficulty since the flame could always be blown out with ease. The beaker or watch-glass was then quickly and quietly

* Chemical News, September 2nd, p. 109 (1870).
† *Ibid.*, August 19th, 1870, p. 91.
‡ *Ibid.*, August 26th, p. 97.

removed from the mouth of the flask with one hand, and the bulb-tube inserted into the neck of the flask with the other; five or more minutes were then allowed for the deposition of any dust which might have entered during the uncovering; if at the end of this time the supersaturated solution still remained fluid, a drop of the liquid was expelled from the bulb-tube, either by warming the bulb with the fingers or by loosening the stopper, *a*. The ethereal solution generally flattened out by the fall; if not, it was readily made to do so by a quick twist of the flask; the ether speedily evaporated, and left the oil, or fatty body, in the form of an iridescent film.

Amongst the substances used were these.

Ethereal solutions. { Citronelle oil (volatile). Olive oil. Russian tallow.
Castor oil.
Camphor in alcohol.
Methylated spirit.
Kreosote.
Oil of turpentine.
Ether.
Benzol.
Chloroform.

Thin films of each of the above were tried at least ten times; in every case the films were iridescent excepting those of olive oil, camphor, and tallow; in most instances the films were set aside for forty-eight hours; and as a further proof one flask of each was allowed to remain for five days and nights; in the meantime the temperature was twice lowered to 33° F. by means of ice, yet although a shower of crystals of the anhydrous salt fell, crystallisation did not ensue, still on uncovering the flasks at the end of the time, and exposing them to the air, the solutions at once became solid. Out of over 100 experiments made with thin films, not a single one crystallised until the solution was exposed, or a dirty body inserted.

May I be permitted to suggest a possible explanation of the activity which Mr. Tomlinson found to be possessed by thin films of oils and other fluids, and of their inertness while in the form of a disk or lens.

Mr. Tomlinson says, "thin fluids, such as ether, benzol, &c., may be taken up by a dropping-tube, fatty oils on a clean glass rod, and the watch-glass gently removed; a drop of the liquid is to be deposited on the surface, the tube or rod to be slowly withdrawn, and the watch-glass replaced."*

To me, this method seems to have the serious disadvantage of exposing both the contents of the flask and the oil or other fluid to the air, and in such a way that, should crystallisation be subsequently set up, you have no means of telling whether it is due to the action of the oil, &c., added or to nuclei which may have slipped in during the necessary movements. For nuclei may have fallen in and been arrested by the lens or disk of oil; all the time that such nuclei float upon this surface of course they do not come in contact with the solution, neither do they, perhaps, when the lens is broken up into small globules, which, although small, are perhaps immense in proportion to the size of the nuclei; but now, on spreading the fluid out into a thin film, which is of excessive tenuity, the nuclei may penetrate through its thickness to the under surface of the film or even sink through, and then act upon the solution.†

That the action which Mr. Tomlinson found set up by thin films starts from several points at once may be accounted for, perhaps, by the nuclei being scattered by the jerk necessary to spread out the fluid; otherwise, the crystallisation might, under other circumstances, have started in the horizontal projection of the flask's aperture, as it usually does when a solution is exposed to the air by the removal of the cover.

(To be continued).

* Chemical News, August 26th, 1870, p. 98.

† That nuclei can do so is shown by the rapid crystallisation of a solution when exposed to the air, although a film of oil, tallow, turpentine, &c., may cover its surface.

ON THE

SOLUBILITY IN WATER OF THE OXALATES OF SODIUM, POTASSIUM, AND AMMONIUM, AT THE ORDINARY TEMPERATURE OF THE AIR.*

By WILLIAM RIPLEY NICHOLS.

In determining the solubilities of the salts experimented upon, the method employed to obtain solutions, saturated at the observed temperatures, was as follows:—Considerable quantities of the salts operated upon—several times as much as would be likely to dissolve in the amount of water used—were put into glass-stoppered bottles, which were then half filled with distilled water, and placed in a pan of water so as to be immersed up to the necks. The operation was carried on in a room where the variation of temperature was slight, such variation being noted by means of a thermometer suspended in the pan of water.

The bottles were shaken conscientiously at frequent intervals for two or three days, and, finally, portions of the solutions were filtered through dry filters into tared flasks, and weighed. As a rule, the thermometer had indicated a constant temperature for several hours previous to the filtration.

The amount of oxalic acid in the weighed solution was determined by titration with permanganate of potassium, standardised against pure oxalic acid, and, from this result, the amount of salt dissolved was calculated.

In every case but one the salts were prepared by myself; and in every case the character and purity of the salt in question was ascertained by titrating a weighed portion of the dry salt with the standard solution of permanganate of potassium.

Oxalate of Sodium, $C_2Na_2O_4$.

This salt was prepared by neutralising a hot solution of oxalic acid with pure carbonate of sodium. The oxalic acid used in preparing this, as well as the other salts, left, upon ignition, 0·03 per cent ash.

Solubility.—Temperature at time of filtration, 13° C.
Temperature had varied, during solution, from 11° to 13·5°.

100 parts of the solution, saturated at 13°, contain:—

I.	II.	III.	Mean.	
3·063	3·066	3·047	3·059	parts of the crystallised salt.

Or 100 parts of water, at 13°, dissolve 3·156 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 31·6 parts of water, at 13°.

Binoxalate of Sodium, C_2NaHO_4+aq.

This salt was prepared by adding 58·5 grms. (1 eq.) of chloride of sodium, in solution, to a hot solution of 63 grms. (½ eq.) of crystallised oxalic acid, and re-crystallising the product deposited from the solution when cold.

Solubility.—Temperature at time of filtration, 10°.
Temperature had varied between 5° and 10°.

100 parts of the solution, saturated at 10°, contain:—

I.	II.	III.	Mean.	
1·40	1·39	1·55	1·45	parts of the crystallised salt.

Or 100 parts of water, at 10°, dissolve 1·48 parts of the crystallised salt.

Or 1 part of the crystallised salt dissolves in 67·57 parts of water, at 10°.

Oxalate of Potassium, $C_2K_2O_4$+aq.

This salt was prepared by neutralising a commercial sample of quadroxalate of potassium with carbonate of potassium, and re-crystallising twice.

Solubility.—Temperature at time of filtration, 16°.
Temperature had varied between 12° and 16°.

(The temperature had remained at 16° for several hours.)

* From the *Proceedings of the American Association for the Advancement of Science*, 1869.

100 parts of the solution, saturated at 16°, contain :—

I.	II.	Mean.
24·73	24·89	24·81 parts of the crystallised salt.

Or 100 parts of water, at 16°, dissolve 32·99 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 3·03 parts of water, at 16°.

Binoxalate of Potassium, $4(C_2KHO_4)+aq$.

This salt was prepared by neutralising a certain quantity of oxalic acid with carbonate of potassium, and adding an equal amount of oxalic acid.

Solubility.—Temperature for three hours preceding filtration, 8°.

Temperature had varied between 8° and 10·5°.

100 parts of the solution, saturated at 8°, contain :—

I.	II.	III.	Mean.
3·680	3·681	3·668	3·676 parts of the crystallised salt.

Or 100 parts of water, at 8°, dissolve 3·816 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 26·21 parts of water, at 8°.

Quadroxalate of Potassium, $C_2KHO_4,C_2H_2O_4+2aq$.

This salt was prepared by re-crystallising a sample of commercial "binoxalate of potash."

Solubility.—Temperature at time of filtration, 13°.

Temperature had varied between 12° and 14·5°.

100 parts of the solution, saturated at 13°, contain :—

I.	II.	Mean.
1·774	1·784	1·779 parts of the crystallised salt.

Or 1 part of the salt is soluble in 55·25 parts of water, at 13°.

Or 100 parts of water, at 13°, dissolve 1·81 parts of the crystallised salt.

Oxalate of Ammonium, $C_2(NH_4)_2O_4+aq$.

This salt was prepared by neutralising a hot solution of oxalic acid with ammonia-water.

Solubility.—Temperature at time of filtration, 15°.

Temperature had varied between 13·5° and 15°.

100 parts of the solution, saturated at 15°, contain :—

I.	II.	Mean.
4·028	4·076	4·052 parts of the crystallised salt.

Or 100 parts of water, at 15°, dissolve 4·22 parts of the crystallised salt.

Or 1 part of the crystallised salt dissolves in 23·69 parts of water, at 15°.

I verified the statement of Heintz,* that this salt is less soluble in a solution of chloride of ammonium than in pure water. I added chloride of ammonium to a concentrated solution of the salt, and there were deposited small crystals which gave by titration 50·93 per cent C_2O_3, showing that they were actually the normal oxalate.

Binoxalate of Ammonium, $2[C_2(NH_4)HO_4]+aq$.

This salt was prepared by neutralising a certain quantity of oxalic acid with ammonia-water, and then adding an equal quantity of oxalic acid.

Solubility.—Temperature at time of filtration, 11·5°.

Variation of temperature, slight.

100 parts of the solution, saturated at 11·5°, contain :—

I.	II.	III.	Mean.
5·89	5·91	5·88	5·896 parts of the crystallised salt.

Or 100 parts of water, at 11·5°, dissolve 6·26 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 15·97 parts of water, at 11·5°.

In order to ascertain whether this salt dissolved unchanged, a portion of that remaining undissolved was titrated with the standard permanganate, and the percentage of oxalic acid found agreed with that of the original salt.

Quadroxalate of Ammonium, $C_2(NH_4)HO_4,C_2H_2O_4+2aq$.

This salt was prepared by adding to half an equivalent of oxalic acid ($C_2H_2O_4+2aq$.) an equivalent of chloride of ammonium (NH_4Cl), as described in the preceding paper.*

Solubility.—Temperature at time of filtration, 7·75°.

Temperature had varied but slightly.

100 parts of the solution, saturated at 7·75°, contain :—

I.	II.	III.	Mean.
2·45	2·46	2·46	2·46 parts of the crystallised salt.

Or 100 parts of water, at 7·75°, dissolve 2·52 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 39·68 parts of water, at 7·75°.

Oxalic Acid, $C_2H_2O_4+2aq$.

A portion of pure crystallised oxalic acid was taken, and its solubility determined to be as follows :—

Solubility.—Temperature at time of filtration, 14·5°.

Variation of temperature, slight.

100 parts of the solution, saturated at 14·5°, contain :—

I.	II.	III.	Mean.
8·668	8·777	8·754	8·733 parts of the crystallised salt.

Or 100 parts of water, at 14·5°, dissolve 9·56 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 10·45 parts of water, at 14·5°.

* *Zeitsch. f. d. ges. Naturw.*, xx., 29.

ON THE

APPLICATION OF IODINE AND BROMINE FOR THE DETECTION OF GOLD WHEN IN MINUTE QUANTITIES.

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

THE large number of non-auriferous, or but slightly auriferous, specimens of quartz and pyritous rocks, which have lately been submitted here for examination for gold, has rendered it very desirable that some quicker, less laborious, and, if possible, more exhaustive, method of analysis, than the current one (that by amalgamation), should be employed.

In recognition of this I have frequently been urged by the director of this department to attempt some other process, and after several preliminary experiments I turned my attention especially to the use of iodine or bromine for this objects.

Both of these substances differ from chlorine especially in their relatively feebler affinities for hydrogen, so there would be the less to fear, that from the generation of hydra-acids, any great preponderance of other matters would be dissolved along with the gold we wish to separate from the sample under examination.

Iodine, indeed, has already been used with advantage in the analysis of certain meteorites, for the separation of the iron and nickel existing therein in a metallic state; these it combines with, leaving the associated silicates, iron-oxides, and sulphides intact.

It was this comportment of iodine with other substances that determined me to the trial of both it and bromine for the purpose named.

The results of my experiments certainly show that either of these agents may be safely and advantageously employed for the separation of gold from its matrices.

The following are the particulars of a few of these experiments, which besides their present use will, I think, be useful in showing what is, approximately, the smallest quantity of gold that can be positively separated and

* CHEM. NEWS, vol. xxii., p. 14.

identified, by a certain course of analysis operating upon a limited quantity. The first time, I believe, anything of this kind has been attempted.

1st. 2 grammes of roasted "buddle headings" from a quartz mine at the Thames, known from previous analysis to contain gold at the rate of one ounce, or so, to the ton, was well shaken for a little while with its volume of alcoholic solution of iodine (tincture of iodine of chemists), then allowed to subside. A piece of Swedish filter-paper was then saturated with the clear supernatant liquid, and afterwards burned to an ash; the ash, in the place of being white, as it would be if pure, was coloured purple; the colouring matter was quickly removed by bromine—a clear indication of the presence of gold. The time occupied by the whole process was twenty minutes.

2nd. 1 gramme of the same "buddle headings," mixed with such a quantity of soil as to reduce the proportion of gold present to 2 dwts. per ton, was allowed contact with its volume of the tincture for two hours, with occasional stirring; a piece of filter-paper was then saturated with the tincture, and dried, five times consecutively, and finally burnt off as before; in this case, also, the colour of the residual ash was purple, and it gave the reaction of gold.

3rd. 32 grammes of siliceous hematite, finely-pounded, was thoroughly mixed with precipitated gold to the amount of 2 dwts. per ton; then ignited, and treated with bromine water. After two hours the solution was filtered, and evaporated to a bulk of 20 minims; this gave a good reaction of gold to the "chloride of tin" test.

4th. 100 grammes of the hematite, with precipitated gold at the rate of ¼ dwt. per ton, treated as before, but this time well washed, at the expiration of the two hours, and the washings evaporated along with the first filtrate, gave a fainter, but still decided, reaction of gold to the same test.

5th. Iodine, as tincture, substituted for bromine in Experiments 3 and 4, gave similar results; the only variation made was, that as a precautionary measure allowing for its feebler, or rather slower, action, I gave contact for twelve hours.

To compare the results of the common amalgamating process with the foregoing, I have made some careful experiments; and I find that it is not certain, with the same expenditure of labour, to get reliable indications of gold, when present in less quantity than 2 dwts. per ton, operating upon about 100 grammes of material, which is about the quantity I usually take.

In summing up the results of these experiments, it appears, then, that for qualitative examinations for gold, or for quantitative determinations in certain cases, iodine and bromine are each superior to mercury. It also appears that a proportion of gold equal to ¼ dwt. per ton, upon a bulk of 103 grammes (about 4 ozs.) of ferruginous matters, can be easily and rapidly detected.

Of course, by operating upon larger quantities, gold could be discovered by this process, were it present in far less quantities, but this is sufficiently near for the majority of cases.

These processes are especially adapted for the separation of gold from sulphides, as the preliminary roasting is extremely favourable to them, not so much chemically as mechanically, I think; the loss in the substitution of oxygen for sulphur, amounting to 25 per cent, by weight, while the volume remains constant (or nearly so); hence there is a corresponding porosity in the product, by which it is certain every atom of it is thrown open to contact with the solution of these agents.

This mechanical accessibility obviously cannot be taken advantage of by mercury.

With sulphides these processes are practically exhaustive, while, at the same time, the simultaneous extraction of other matters is avoided, or, at any rate, is so trifling, that the proper tests for gold can be safely applied directly to the concentrated solution.

Regarding the choice between iodine and bromine, I would prefer the former, when mere traces of gold are supposed to be present; or if the ore is in a finely divided state, as is generally the case when the matrix is iron pyrites.

In the roasting of such pyrites it is necessary to raise the temperature towards the end to a full-red heat, in order to decompose the ferruginous sulphates, since if these remained much iron would get into the solution.

In the case of much carbonate of lime being present, it is proper to gently re-ignite the roasted mineral, &c., with carbonate of ammonia, or much lime might get into the iodine or bromine solution.

On the other hand, a very high temperature is to be avoided, for, from my own experience, I find a considerable quantity of fine gold can escape detection in this way, by the partial vitrification of the more fusible of the silicates.

The identification of gold by the combustion of its salts with filter-paper, as suggested in this paper, seems to promise a rapid method of estimating it, comparatively, by the aid of a series of prepared test-papers, representing gold in different degrees of dilution.

ON THE

TREATMENT OF GELATINOUS PRECIPITATES.

By THOMAS M. CHATARD.

The inconveniences and loss of time which attend the washing of gelatinous precipitates are familiar to all chemists. Even the methods of washing recently introduced by Bunsen are not always perfectly satisfactory in their operation when applied to this class of substances. The following method will be found, I think, to give results which leave nothing to be desired:—The solution containing the substance to be determined is to be simply evaporated to perfect dryness with a small excess of the precipitant, and the gelatinous mass stirred with a rod until it becomes a perfectly dry powder. In this manner, the precipitate diminishes extremely in bulk, and may then be washed with the greatest ease upon the filter. The evaporation is usually effected with sufficient rapidity on a water-bath. The following analyses will be sufficient to show the degree of precision attainable by this process in the cases of some of the more familiar precipitates:—Weighed portions of potassic dichromate were dissolved in very small portions of water, reduced with chlorhydric acid and alcohol, the excess of alcohol expelled, and ammonia added in excess. After evaporation, in the manner above described, the chromic sesquioxide presented a greenish blue granular powder very easily washed.

0·7782 gr. $K_2Cr_2O_7$ gave 0·4023 gr. $Cr_2O_3 = 68·02$ per cent chromic acid.

1·5646 gr. $K_2Cr_2O_7$ gave 0 8102 gr. $Cr_2O_3 = 68·13$ per cent chromic acid.

The formula requires 68·04 per cent.

Alumina, treated in the same manner, is also very easy to wash.

2·4097 gr. potassic alum gave 0·2626 gr. $Al_2O_3 = 10·89$ per cent.

1·9571 gr. potassic alum gave 0·2130 gr. $Al_2O_3 = 10·88$ per cent.

The formula requires 10·86 per cent.

The process applies with almost equal advantage to iron. Weighed portions of ammonio-ferrous sulphate were dissolved in water, and sodic chloride added in large excess, to furnish solid matter to be washed out. The iron was then oxidised with nitric acid, precipitated by ammonia, and evaporated as above.

1·5824 gr. gave 0·3229 gr. $Fe_2O_3 = 14·28$ per cent iron.

1·4840 gr. gave 0·3019 gr. $Fe_2O_3 = 14·24$ per cent iron.

The formula requires 14·29 per cent.

Nickelous carbonate also loses its gelatinous character when treated as above. 0·2201 gr. metallic nickel gave, after solution, precipitation as carbonate, and reduction by hydrogen, 0·2199 gr. metallic nickel = 99·91 per cent of the quantity taken. Cobaltous carbonate may be treated in the same manner, but the alkali cannot be completely washed out, and the method is, in this case, not to be recommended.

It seems, at least, extremely probable that other gelatinous oxides and hydrates will give equally good results when treated in the manner which I have described.—*American Journal of Science.*

ON FERMENTATION.*

By Professor A. W. WILLIAMSON F.R.S.

LECTURE I.

(Continued from p. 236).

AMONGST the processes which really are analogous to fermentation in their nature, but which differ in one particular, I must mention one other, the process of forming vinegar, or acetic acid. This large bottle contains vinegar, in a form which most of you, I dare say, have not seen. These fine white crystals are the pure substance which, mixed with water in an impure state, are generally known by the trivial name of vinegar. We call that acetic acid, or hydric acetate. The formation of this body from alcohol represents a variety of fermentation, which is of considerable importance and of frequent occurrence. Everybody who has noticed the process which takes place when animal or vegetable matter is left to itself in contact with air, especially in moist localities, must have observed that there is a gradual disappearance of the organic matter. For instance, if you leave a piece of wood in a moist place, under certain conditions of very frequent occurrence which are favourable to this process, the wood gradually gets soft, and becomes transformed into a brown substance; and, if you leave it long enough—in this country, several years generally would be needed for this purpose—it gradually disappears. If you were to put a piece of that decomposing wood into a closed glass vessel, and examine the air above it, you would find that the wood was really burning. I am using the word combustion in the ordinary chemical sense—I mean by that word that the oxygen of the air which you have enclosed with the wood is being taken up by the wood, and the products of combustion, carbonic acid and water, are being formed rom the substance of the wood. One great class of the processes of fermentation is of that kind. They consist not in a mere breaking up of the materials already contained in the organic substance, but a change of their arrangements, which is due, more or less, to the absorption of oxygen; and this formation of acetic acid, or vinegar, is a case of that kind. In fact, if we were to leave some ordinary fermented wort in an open vessel, so that the alcohol were left there in the mixture in which it had been formed, we should find that the alcohol would gradually disappear, and give place to an acid substance. The process is well known to wine-makers and to brewers, and their art consists, amongst other things, in the avoidance of this process of the oxidation of their alcohol. While the acetic acid is being formed, oxygen from the air is taken up; and, in that respect, this process of acetic fermentation differs from the other three processes of fermentation which I have described. When you make alcohol and carbonic acid from sugar, the air takes no part in the process; when you make lactic acid from the sugar, the air is not wanted; and when you make butyric acid from lactic acid, then again the air may be completely excluded, and the process will go on without it. But, when you make acetic acid from alcohol, you must of necessity allow the free and continuous access of air, and the air gives up some of its oxygen to this fermenting alcohol, to transform it into acetic acid and water by a true process of fermentation.

Now, the question arises whether this formation of acetic acid ought to be classed, as I am at present classing it, amongst the processes of fermentation. If it is due to the absorption of oxygen, you might naturally inquire whether one ought not to place it amongst the common processes of combustion, and it is right that I should state that by some authorities it is at present so classed. My reason, however, for stating what I have done, that it is a process of fermentation, is this, that it is usually affected by the action of a peculiar organism, called the vinegar-plant, an organism which I shall have occasion to show you hereafter, which does exert in that particular process the function of taking up oxygen from the air, and of inducing the alcchol to combine with it. There are many other processes by which we could get it, but the actual process by which we do get it is a process in which this vital organism, the vinegar-plant, is the agent of its formation. It might be made by mere processes of combustion, but it is made by a process of fermentation.

There is one singular feature in the first and best known of these processes—the alcoholic fermentation—which you will notice when I tell you something of the way in which the processes of fermentation present themselves, even without very great care on the part of the observer. If, for instance, you were to express the juice of some sweet fruit—say grapes—and if you were to leave that expressed juice in contact with the air for a little time, having first squeezed it through some suitable cloth or filter, so as to have it clear, of course there would be no solid particles in it when you put it aside; but, if you leave that in a tolerably warm place, in contact with the air, you would find that little solid particles would appear in this juice, that they increase in number, and that, in proportion as they increase in number, and as the quantity of them becomes greater, so does the process of effervescence—the evolution of gas from the grape juice—become more and more rapid. These little solid particles, which are not present at first in the grape juice, but which gradually make their appearance when it is exposed to the air, are what we commonly call, in the ordinary case of alcoholic fermentation, in this country, yeast—either beer-yeast or wine-yeast; it is the same organism in each case. The peculiarity of the process is this, that these substances—this yeast—which seems to make the sugar into those products which I enumerated to you, does not disappear while doing the work, but is produced by the very process. The more active the production of these yeast cells, and the more speedy the growth of these yeast cells, the more effective and rapid is the process of fermentation, and no fermentation of the kind which I am speaking of at present—the alcoholic fermentation—has ever been known to take place in the absence of these organisms. That circumstance I just mention briefly at present, but the fact that these yeast cells appear whenever the process is going on—and the more they grow the more rapid is the fermentation—has led people to suppose at first, and to believe afterwards, that these yeast cells were the agents of the transformation, the active substances which decomposed the sugar in contact with the water, and induced the transformation which we noticed. Now, the very fact that one of the two substances which are reacting upon one another chemically (because the changes are chemical in their fundamental nature), should not disappear, but should rather increase by the process, is entirely anomalous—it is entirely at variance with the simplest and best known facts of chemistry, so much so, that if it were not established upon incontrovertible evidence, I believe that most chemists would be inclined to disbelieve it, and to say it cannot be—it is impossible—it is a mistake. If you tell me, as a chemist,

* The Cantor Lectures. Delivered before the Society of Arts.

that this yeast is transforming sugar by its action on the sugar, and that, instead of being consumed, the yeast is actually increased in quantity by doing that work, I should say it is nonsense—it cannot be, because, in all the cases of chemical action which I know best, nothing of the kind occurs, but the very opposite. When one substance acts upon another, each one disappears in the process, and is transformed into a product having other properties. I need hardly give you illustrations of that; but one or two simple cases may not be useless, as serving to fix clearly this important circumstance in your minds.

I will take, at first, one of a particularly elementary and simple kind, a process of combustion. I will take a little strip of metal, magnesium wire, and will hold it for a short time in the flame of a spirit-lamp, so as to raise it to a sufficiently high temperature. The light you see emitted is due to the combustion of the oxygen in the air with the metal magnesium, which I hold in my hand. This is one of the simplest possible cases of chemical action. The metal has disappeared. The strip of wire is gone, and oxygen from the air disappeared also. At the same time a white powder was formed. I dare say you did not notice it, but here is a quantity of the same substance in a bottle. It consists of oxygen from the air combined with the metal magnesium, and the point is this—that all the magnesium which took part in that process disappeared and went to form this white powder, and all the oxygen which took part in the process also disappeared. The two united together, each disappeared as such, and went to form this new product. And, moreover, we can tell, from an examination of the proportions in which the substances combine, exactly what weight of oxygen would disappear for every part by weight of magnesium. If you burn, for instance, 3 grms. or 3 lbs. of magnesium, you would require exactly 2 grms. or 2 lbs. of oxygen. For instance, 3 lbs.' weight of magnesium would combine with 2 lbs.' weight of oxygen, and the product of the two together would be 5 lbs. in weight. I may show you the same thing with soda—not the substance which is commonly called by that name, which is a carbonate of that base. I have here a little pure soda solution in a bottle. I will pour some into a beaker-glass, and I will show you one property which characterises it—viz., that of changing the colour of this red paper into blue. Now, I will pour some of this acid body, the oil of vitriol, into another beaker-glass. If I put the paper which has been discoloured into this pure acid, it would be dissolved; but I will dilute some of it with water, and then you will see that paper, which has been rendered blue by the agency I have just used, is brought back again to red by the agency of this acid. Now, if I mix the acid with the soda, we shall have audible evidence of violent action going on. I will not go on with the process, but I have purposely taken the two substances in presence of very little water, in order to show you that the heat evolved makes the liquid boil with great violence. I could have avoided that by adding water in the first place, but I wished to show you the vigour with which they unite together. If I were to go on adding acid to the soda, little by little, feeling my way until I had just completed the action, I should have got some water formed and some of the beautiful salt which I have here, a body which is neither soda nor acid; it is a salt called Glauber salt, or sodic sulphate, and all my materials would have disappeared in the process. If I use them in proper proportions, all the acid and soda would disappear, and go to form these two other products. I might dissolve some of this sulphate in water, and might put red paper or blue into it, and it would not affect either of them; it is perfectly neutral in that respect. The proportions by weight in which this combination takes place is this. If I add 40 parts, by weight, of soda, and 49 of oil of vitriol in a state of purity, I should have as the result, 18 parts by weight of water, and 71 of sodic sulphate; and, if I add together the weight of my materials and the weight of my products, I get the same—89. Nothing disappears in the process; all the acid and all the base which takes part in it is employed. Each particle which took part in the process disappeared as such, and it passed over into another form.

I will mention one other case, because it is somewhat more complex. I may take the case which I was showing you just now, the white marble and hydric chloride, or muriatic acid, which I used for making the carbonic acid gas. In that case, I used two materials, carbonate of lime, as it is commonly called, and hydrochloric acid. We get three products—on the one hand is a salt, which is commonly called chloride of calcium, a solid substance used for drying gases, as it has a great affinity for water; another is water; and the third, as I showed you, carbonic acid gas. There, again, we have precisely the same thing. All the marble and all the hydric chloride which takes part in the formation of those three products disappeared as such, and they resolved themselves into other compounds possessing different properties; but the weight of the products is equal to the weight of the materials. That rule holds good throughout all ordinary cases of chemical action.

On the other hand, in fermentation it is not so; one of the active substances is formed, and the more active the fermentation, the more does it grow. In fact, if you want to get yeast, you must go to a place where the breaking up of sugar into alcohol and carbonic acid is going on; or, if it is in the south, you must go to where wine is being made—you go to a wine-maker and get the yeast from him. The only way of getting yeast is from that process of fermentation which sets in spontaneously under the conditions I named to you.

(To be continued.)

DR. SEYFERTH'S PROCESS FOR THE PURIFICATION OF SYRUPS AND MOLASSES IN THE MANUFACTURE OF SUGAR.

The juices and liquors employed in the first extraction of sugar from the raw material it is contained in, as well as the syrups resulting from the sugar refining processes, all generally contain a certain quantity of alkaline substances, varying, however, in quantity with the various conditions of the soil on which the beet-roots have been grown and the mode of cultivation. The juice of the ripe sugar-cane, however, is at the moment of being squeezed out of the cane slightly acid to test-paper. By treating the saccharine juices with milk of lime, several of the bases of the alkaline salts present in the juices are separated from the acids they were at first combined with, and by thus being set free and remaining mixed with the sugar, impede its crystallisation. One part of alkaline matter can absorb as much as four parts of sugar; and some kinds of molasses (chiefly from beet-root) contain as much as 8 per cent of alkali.

The means hitherto tried to remedy this defect, viz., neutralisation of the alkalies by acids, have failed in practice, chiefly for two reasons: first, because the acids have not been applied at such a stage of the process of manufacture as to enable the acids to seize upon the whole of the alkalies; and secondly, because it has never been possible to prevent the injurious effect of even a very slight excess of acid upon the sugar itself; while, moreover, a difficulty is encountered by the very variable quantity of alkali present, whereby the proper quantity of acid to be applied varied every moment, thus rendering their application totally unsuited in any but very skilled hands. Among the acids applied sulphuric and phosphoric have been most used, but their use could not but be very limited, since even a very slight excess thereof was far more to be dreaded, on account of its highly injurious

effects upon the sugar, than almost any amount, so to say, of alkalies. Sulphurous acid has been used and recommended in various forms, even as far back as 1810 (Proust), both on account of its activity as acid in saturating alkalies, as well as its power as a bleaching agent, by thus rendering the sugar more white-coloured.

Dr. Auguste Seyferth, managing-director of the Brunswick sugar (beet-root) refinery, has hit upon a plan for the use of sulphurous acid, which, according to the unanimous and unbiassed testimony of no less than 100 proprietors of establishments wherein the process invented and brought out by the Dr., since September, 1869, is applied, answers the purpose admirably, yielding more produce and of better quality in every respect. The process alluded to consists essentially in the introduction of sulphurous acid, either in gaseous form, or in very weak aqueous solution, into the vacuum pans. By this arrangement it is possible to bring all particles of the sugar solution (syrup) into contact with sulphurous acid, and to eliminate, by the joint action of heat and vacuum, any excess of that acid, which, however, not only saturates free alkalies and carbonate of lime, but also sets the organic acids, which might be present as alkaline salts, free from these combinations; the sulphurous acid taking hold of the bases they were combined with, while the greater part of these organic acids are volatilised along with the steam, and thus the sulphurous acid promotes the good and ready crystallisation of the sugar, while its action as a decolouriser comes also advantageously into play.

The Seyferth processs embraces two main operations, viz., the manufacture of the sulphurous acid as gas, or as aqueous solution, and the application of the acid (chiefly in aqueous solution, being more readily manageable) and its introduction in the vacuum pans. The sulphurous acid is manufactured at the works (beet-root sugar manufactories or sugar refineries) by the well-known expedient of burning sulphur in suitably constructed ovens, and carrying the products of combustion, previously cooled so as to condense any vapours of sulphur, into a leaden vessel wherein the gas is met by a suitably arranged current of water so as to become entirely absorbed. The aqueous solution thus obtained is put into casks, or other suitable vessels, and from these a tube, provided with taps, leads to the vacuum pans, wherein the liquid is sucked simultaneously with the sugar solution. The party in attendance upon the boiling in the vacuum pans, while causing the sulphurous acid to be aspired, takes care to test from time to time (this is done by means of the contrivance technically known as proof-stick) the contents of the pan by applying blue litmus paper, so as to ensure the contents of the pan remaining alkaline; but if by a mishap the acid is in excess, this is remedied by sucking in a fresh quantity of sugar solution, while a slight increase of the rapidity of evaporation (the turning on of more cold water to the condensers) will rapidly eliminate and volatilise any excess of sulphurous acid, which, when in quantities of 50 to 100 kilos. excess of the weak solution, does not affect the sugar.

The quantity of sulphurous acid solution applied varies from 4 to 8 or from 10 to 15 per cent of the bulk of liquid (syrup) to be evaporated, but these figures are not absolute but only relative, since experience has already proved that the requirements differ for different localities. The process alluded to is stated to possess, besides the advantages already named (production of better quality and larger quantity of sugar), the good qualities of being applicable at very little cost; to require no inconveniently large space; to be applicable to any already existing manufactory without causing any temporary stoppage of work; its application is readily learned by the sugar boilers. According to the communications made on this subject by the members assembled at the general meeting of German sugar manufacturers and refiners, at Berlin (last May), and a similar meeting lately held at Prague, this process is highly appreciated, and largely eulogised as an immense improvement in this branch of industry.

CONTRIBUTION TO AN IMPROVED METHOD OF ANALYSING MINERAL WATERS.

By Dr. MOHR.

WHEN large quantities of an alkaline mineral water are evaporated in a porcelain dish, the saline matters, chiefly carbonates of the earths, form a crust at the bottom of the vessel, so fixed that it is impossible to loosen it, while it need hardly be said that the residue cannot be weighed, while in the large basin, with accuracy. The author, therefore, adds to the water a sufficient quantity of formic acid, so as to render the fluid distinctly acid to test-paper, and then proceeds with the evaporation cautiously, and finishing it on a water-bath or in the drying box; the residue is taken up with a small quantity of distilled water and the solution filtered through a small filter, the filtrate being run into a platinum crucible, or basin of sufficient size, yet at the same time suitable for accurate weighing. The filter contains all the silica that was contained in the water, and, after washing and drying that substance, is readily estimated by well-known methods.

The filtrate in the platinum vessel is evaporated to dryness, and gently heated to redness; the formic acid does not, as acetic acid does, leave a carbonaceous residue, but is entirely converted into volatile compounds, viz., two atoms of carbonic oxide, and one atom of water; all the salts, therefore, which the mineral water contains, are, after the heating to redness, converted to the same condition they were in before the addition of the acid, and the residue, after weighing, is treated with boiling distilled water; this solution is filtered, and the insoluble residue on the filter treated by the well known methods.

The soluble soda-salts contain, or rather are combined with, carbonic and sulphuric acids and with chlorine; in order to estimate with the same quantity of substance each of these three acids, the author suggests the following method:—The aqueous solution of the salts is boiled, and, while boiling, a neutral solution of acetate of lime is cautiously and drop by drop added, so as to decompose the carbonate of soda with the formation of carbonate of lime in the form of arragonite; the carbonate of lime is collected on a filter and to the filtrate is added acetate of baryta, while the fluid is kept in ebullition; the precipitate sulphate of baryta is collected again upon a filter, serving the purpose of the estimation of sulphuric acid; in the filtrate the chlorine is estimated by means of nitrate of silver, the solution having been acidified, previous to the addition of the solution of that salt, with nitric acid.

In this manner three different precipitates are obtained, from each of which the calculation for the corresponding soda-salts is made. Carbonate of lime $\times$ 1·06 = carbonate of soda ($\frac{53}{50}$ = 1·06). Volumetrically, the carbonate of soda is first estimated with the aid of tincture of cochineal and 1-10th of nitric acid; in the same fluid chlorine is volumetrically estimated by means of a solution of chromate of potassa, and 1-10th of nitrate of silver solution; after the addition of chlorhydric acid, the solution is filtered and the sulphuric acid in the filtrate is estimated gravimetrically by well-known methods.—*Zeitschr. für Anal. Chem.*

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

THE opening meeting of the session took place on Monday night in the Lecture Hall, Corporation Buildings. Alexander Whitelaw, Vice-President, delivered the introductory address.

After making a feeling allusion to the death of Dr. Penny,

Dr. W. Allen Miller, and Dr. Matthiessen, and expressing regret at the loss which chemical science has sustained thereby, Mr. Whitelaw proceeded to notice some of the most recent discoveries and improvements in industrial chemistry. Among others, he referred to Mond's process for the recovery of sulphur from alkali waste, Weldon's continuous method of obtaining chlorine, Deacon's process for making chlorine without the use of manganese, by passing hydrochloric acid gas over hot bricks saturated with sulphate of copper, whereby, by a peculiar reaction hitherto unknown, water and chlorine are produced, while the copper salt remains intact and active for an indefinite time. After touching on various points of interest with regard to the utilisation of certain by-products, Mr. Whitelaw described a new process now in operation on a large scale for the recovery of the small quantity of the precious metals in the copper liquors obtained from burnt Spanish pyrites, by Henderson's process. He also described the process for the manufacture of ferro-manganese or spiegeleisen, from the residual oxide of iron from the above process. Passing to organic chemistry, Mr. Whitelaw described a new discovery, by Bock, of Copenhagen, and now in operation for the manufacture of stearic acid without either lime saponification or distillation with superheated steam. Before concluding, Mr. Whitelaw shortly reviewed a recently-published "Digest of the Sewage Question," prepared for the committee of the British Association, and stated that, after a careful study of the whole evidence, and notwithstanding rather strong preconceived opinions to the contrary, he was forced to the conviction that the soil is the only perfect purifier of sewage—that intermittent filtration through the soil—in other words, irrigation by sewage—is the only thorough way of utilising the manurial matters contained in, and sweetening the effluent waters from sewage. That subsoil, water, and rain-water should be, if possible, run by means of deep drains into the nearest water-course; and that the house-sewage should be conveyed by means of pipe sewers of moderate size, capable of being flushed to the out-fall works, there to be roughly filtered before being used for irrigation. Mr. Whitelaw then read extracts in support of his opinion that sewage farms are not hurtful to health, but are, on the contrary, if properly managed, the reverse.

NOTICES OF BOOKS.

Snuff-Taking: its Utility in Preventing Bronchitis, Consumption, &c. (With prescriptions.) By JOHN C. MURRAY, M.D., F.A.S.L. London: J. Churchill and Sons. Newcastle-on-Tyne: D. H. Wilson. 1870.

THIS essay is an extension of a paper read before the Medical Section of the British Medical Association, held at Newcastle-on-Tyne in August last, and the subject it treats of is fairly and scientifically put forward. It is divided into seven chapters, and contains, moreover, a large appendix, including prescriptions and correspondence. The author has done good service in calling the attention, not only of medical men, but also of the public in general, to the subject of snuff-taking.

Elementary Questions in Chemistry for Students. First series: Thirty Papers on Heat and Metalloids. By THOMAS WOOD, Ph.D., F.C.S., Lecturer on Chemistry at the Brighton and Lancing Colleges, &c. London: J. Helm, 10, Brownlow Street, Holborn. Brighton: H. C. Treacher. 1870.

THERE are two methods of giving young people instruction in chemistry, in the absence of a regular working laboratory. First, by lectures only, without any examination or further notice of the subject. This plan awakens interest in the pupils, teaches them to observe, enlarges their ideas, acquaints them with many things necessary for everyone to know, and is comparatively of much use; but it is almost valueless as far as really mastering the science is concerned. Secondly, by lectures given in the regular school hours, partaking more of the nature of an ordinary school lesson, where any boy may be asked questions during the lecture, and an examination on each lecture is held immediately afterwards—the examination being made compulsory, like any other work. For some years past the plan has been followed at the Brighton College of setting the examination paper *before* the chemical lecture is delivered, the lecturer answering, in the course of his lecture, each question on the paper. The boys subsequently answer the questions in writing, each master looking after the answers in his form. Such success has attended this plan that Dr. Wood has been induced to print these questions, so that a similar plan may be followed at other schools. It is proposed to print three series of questions in sets of ten, of which the present series is the most elementary. The first series of papers requires lectures illustrated by simple experiments, intended only to teach plain facts and give elementary information, such as shall enable the pupil eventually to grasp the principles of the science in a more advanced course of study. The second series will enable the examiner to see if the boy has intelligence and ability sufficient to put the facts together which he has learnt in the first course of lectures, use them in a rational way, and understand the principles on which the science is built. The third series will be a set of still more advanced questions, requiring the student to use his reasoning power, and to apply the principles of the science with accuracy to new cases. The series before us is intended to accompany a first course of lectures, and is so arranged that each question requires only a single answer, and many of them may be answered by a word. The author's little book is published very opportunely, now that the Elementary Education Act is about to come into operation.

We sincerely hope that enlightened, liberal minded, and clear headed men will be elected as members of the Education Board, and that they will see that the first and foremost point in education is to make children well grounded in the elements of all branches of knowledge. Chemistry pertains especially, along with other physical sciences, to the subjects of sound elementary education, which ought to be thoroughly unsectarian, in the fullest and strictest sense, so absolutely that even Mahometans or Buddhists from India, as well as Jews and Christians, can attend the school and study together. The example of the United States, of Switzerland, Belgium, and the Netherlands, as well as of other countries, proves, not only the possibility, but also the perfect fitness, of this arrangement. And it should not be forgotten that, as regards the teaching of the elements of physical and natural history sciences, they widen a man's views, sharpen his intellect, and give him power in various ways; and this power, rightfully and judiciously applied, cannot fail to benefit the individual, as well as the agglomeration of individuals, termed the nation.

CORRESPONDENCE.

PRESERVATION OF STONE.

To the Editor of the Chemical News.

SIR,—In a letter by Mr. A. H. Church, which appeared in the last number of the CHEMICAL NEWS, the originality of my proposal to apply the superphosphate of lime as a means of preserving stone from decay is called in question, and the report of the Chemical Sub-Committee (Houses of Parliament) is cited, as proving a prior use, in this country, of phosphoric acid and the superphosphates for the purpose mentioned. But Mr. Church has failed to notice that this report bears date June 17th, 1861—one

month later than my proposal (May 13th)—and that it is to my process that reference is here made in the report. I have Coignet's specifications now before me, and no mention is made of the superphosphate being applied to stone, but only to the surface of large artificial blocks, for the purpose of enabling them to take a coat of paint.

If Mr. Church (or Mr. Ransome) believes he has secured a good patent for a "Combined Process," embodying your own dialysed silica and my superphosphate, what is to prevent me from patenting an "Improved Combined Process," which differs only from his by finishing up with a last wash of superphosphate applied upon the other ingredients? This would prove quite successful, but, in the event of such a course being permitted, to what monstrous absurdities would the Patent Laws of England be lending support!—I am, &c.,

JOHN SPILLER.

London, Nov. 14th, 1870.

MISCELLANEOUS.

Method for Repairing Porcelain Evaporating Basins when Cracked.—Dr. Waltl recommends, first to dry the vessels thoroughly in a drying-stove, and next to fill them with a rather concentrated solution of silicate of soda and leave the solution in the vessel for about twenty-four hours after the liquid has been poured out. The vessel is gradually dried at a gentle but increasing heat, and it will then be found to hold liquids again and be fit for further use.

Cleaning Oil Painted Surfaces.—Take a piece of soft flannel, put it in warm water, and squeeze it till it feels dry; next dip it gently on to some very finely pulverised French chalk, and rub the painted surface with the flannel; the effect will be the removal of all dust, greasy matter, and dirt; the surface is next washed with a clean sponge and water, and dried with a piece of soft wash-leather. This method does not injure the paint like soap, and produces a very good result.

Testing Carbonate of Lead for its Goodness as an Ingredient of the Manufacture of Crystal Glass.—Dr. A. Neujean.—Since the presence of iron and copper are the only impurities which interfere with the use of white lead for the purpose above-named, the author tests for the presence of these substances colorimetrically in the following manner:—From 20 to 40 grms. of the substance (white lead), if apparently very pure, and only 10 grms. if obviously impure, are dissolved in dilute sulphuric acid, and next precipitated by means of sulphuric acid; the liquid having been filtered is evaporated and reduced to a small bulk, and next, by the addition of water, made up to a constant volume, after which a few drops of sulphocyanide of potassium are added; the presence of copper is tested for by a similar operation, ammonia being applied instead of the salt just alluded to.

Preparation of Tannic Acid.—O. Rothe.—The author recommends the following process as the best and simplest:—Eight parts of pulverised nut-galls (the Chinese galls are preferred by the author) are macerated for two days in a mixture of twelve parts of ether and three of highly rectified alcohol, care being taken frequently to move the vessel containing the mixture. The liquid having been poured off from the residue, the same quantity of ether and alcohol is poured on the powder, and, after a short maceration, the pulpy mass is pressed; the mixed liquids are left at rest for some twenty-four hours, after which there are added to the fluid twelve parts of water; this having having been done, the mixed alcohol and ether are removed by distillation, the greenish resinous matter which will be found floating on the residual liquid is removed by filtration, and after that the liquid is evaporated to dryness by means of steam and the residue ground to powder.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Journal de Pharmacie et de Chimie, September, 1870.

This number contains the following original papers and memoirs:—

Modifications which the Alkaloids of the Cinchona Barks Undergo under the Influence of Certain Physical and Mechanical Agents.—M. Carles.—The author relates the results of some experiments made with the view to investigate the action and influence of long-continued grinding and exposure to air of the powder thus obtained of cinchona barks, and, next, the action of sunlight, moisture, and heat upon that powder. It appears that the mechanical operation of grinding, even if continued for some time, does not alter in composition, nor lessen the quantity of the alkaloids present in the bark; but exposure to sunlight in a stoppered bottle for about a month decreases the quantity of alkaloids by about 5 per cent, while the prolonged action of moisture and heat produce similar results.

Decomposition of Oxalic Acid.—M. Carles.—The contents of this paper give an account of a series of experiments made with the object of ascertaining the action of currents of pure oxygen and hydrogen upon aqueous solutions of pure oxalic acid, as regards the decomposition of that substance into carbonic and formic acids at a temperature of 100°. The author has also found that perfectly pure nitrogen has the same effect upon a solution of pure oxalic acid at 100°, dissociating it into carbonic and formic acids; but the cause of this action is not yet explained.

Modifications which Inuline undergoes, Spontaneously or by the Combined Action of Heat and Water.—M. Lefranc.—This lengthy essay treats, in the first place, on the changes which inuline suffers in the living parts of plants (chiefly roots and tubers). It appears that the inuline is gradually converted into a sugar-like substance, which the author calls *inulose*, and into soluble inuline, which, the author states, partakes, in many of its properties, of levuline. The former of these substances is optically neutral, capable of fermentation, and has the aspect of glucose. Levuline is levogyrate, not capable of fermentation, and has the aspect of starch; neither of these two substances are detected by the cupro-potassic reagent. The author states, that when inuline in solution is boiled for thirty hours with water at 100°, it yields the same products as those just mentioned as being the result of the action of the vital process of the plants upon inuline.

Experiments made with the Salts of Manganese.—A. Commaille.—This lengthy essay treats on the action of several substances (chiefly acids) upon permanganate of potassa. The essay is divided into the following sections:—Action of nitric, sulphuric, hydrochloric, iodic, arsenious, oxalic, acetic, tartaric, citric, benzoic, and uric acids upon the permanganate of potassa, the action being aided by alcohol, ether, and sometimes electricity. It is not well possible to give a succinct account of the reactions which take place in each instance, but it appears that, when the permanganate is dissolved in chlorhydric acid, and an electric current conducted through that solution, hydrogen gas is abundantly given off. The same phenomenon takes place under similar conditions with a solution of the permanganate in oxalic acid; but, without the electric current, ozonised oxygen is given off.

On Melassimetry.—M. Maumené.—This paper treats on the estimation of the value of raw sugars; its contents are reserved for full translation.

Properties of Iodic Acid.—A. Ditte.—This paper treats on some reactions of anhydrous and hydrated iodic acid. The former substance is a white-coloured powder, very soluble in water, and insoluble in ether, chloroform, sulphide of carbon, and hydrocarbons generally; sp. gr. at 0°, 4·487. The oxidising properties of this substance are very energetic. At the ordinary temperature, this action is not so manifest; but, at an elevated temperature, this acid acts energetically, even upon hydrogen (under pressure), upon carbonic oxide, sulphurous acid, and ammonia, while even at the ordinary temperature sulphuretted hydrogen gas and hydrochloric acid gas are acted upon. The monohydrated iodic acid is also a solid substance; sp. gr. at 0°, 4·629. The reactions of the concentrated solution of this acid, and its behaviour with most of the metalloids, is described at length. Benzine and acetylen are decomposed by anhydrous iodic acid at 220°, yielding carbonic acid and water

Monobromated Iodhydrates and Chlorhydrates of Ethylen and Propylen.—E. Reboul.—This essay treats on the action of iodhydric and chlorhydric acids upon the substances above named. When iodhydric acid acts upon the monobromated ethylen at the ordinary temperature, there is only formed an iodhydrate of the monobromated ethylen; but, if the action is assisted by heat, two isomeric compounds are formed. The general result of the action of the hydracids upon the monobromated compounds of ethylen and propylen is the formation of isomeric compounds; but, whereas with bromhydric acid the degree of its concentration is in play, with iodhydric acid only the temperature is of any influence. Chlorhydric acid yields only one product, which is a chlorhydrate for bromated ethylen and a chlorobromide for bromated propylen.

hard glass, one of the before-mentioned tubes being inserted into either limb. Crystallisation, when set up in one limb, travelled round the bend and up into the other, from which crystals were transferred, as before, to a beaker or flask of solution also under the bell-jar.

The three modifications of this form of experiment were tried time after time, and always with the same unvarying result. Solutions which were supersaturated although not perfectly, and therefore less sensitive, were operated upon in this way; but, even with such less favourable circumstances, the normal crystals always started crystallisation in the solution to which they were added.

To ascertain, if possible, whether nuclei, other than crystals of the normal salt, were carried by the tube or its adhering crystals, a capsule of sulphuric acid was placed under the bell. The crust of crystals was, by this means, dried, and became effloresced to a greater or less extent. Now, on lowering them into a supersaturated solution of alum or of magnesic sulphate, they were proved to be inactive.

But such dried normal crystals were active to a solution of sodic sulphate, even after three days' exposure to the sulphuric acid;* whereas, a solution allowed to evaporate spontaneously on the surface of the tube under cover, forms (modified) crystals, which, as previously related, were found to be inactive. It seems as if the normal crystals become covered with a coating of effloresced anhydrous salt which acts as a protection to the underneath portions, in the same way as oxide of lead does to metallic lead; hence it takes a long time to convert a crystal of the normal salt into the anhydrous by simple exposure to dry air, although it is an exceedingly short operation to perform at temperatures superior to 34° C.

In conclusion, I merely sum up the results of the foregoing experiments.

Any explanation or theoretical considerations are left for a future paper, in which I hope to give the work of other series of experiments now in hand and in projection.

(1.) About 120 experiments were made with thin films, in the manner and with the precautions already detailed, but not a single solution crystallised under their influence.

(2.) Out of 90 odd experiments made with crystals of the normal salt in the manner described, in no single instance did they fail to be active.

London, October, 1870.

EVIDENCE CONCERNING THE

GERM THEORY OF FERMENTATION

AFFORDED BY THE ACTION OF CERTAIN SUBSTANCES WHEN SUSPENDED IN THE AIR.

By ARTHUR ERNEST SANSOM, M.D.

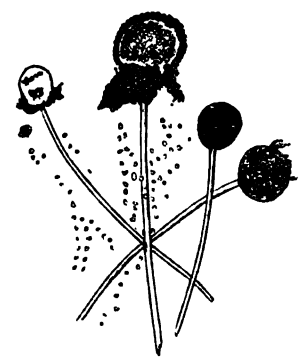
(Concluded from p. 242.)

Expt. 2.—It was intended to examine the influence upon vegetable development when various materials prone to present fungoid organisms were subjected coincidently to the influences of carbolic acid, (*a*) in the fluid containing the fermentescible matter; (*b*) in the air alone which was supplied to the materials.

It is necessary to explain that M. Pouchet adduced as evidence, in favour of the theory of spontaneous generation, the development of a peculiar *Aspergillus*, which he himself discovered and named from the circumstances of its formation *Aspergillus primigenius*. Into a flat porcelain dish he poured boiling paste made from wheat-flour, so as to form a layer one centimetre thick. When this began to set he wrote upon its surface with a pencil dipped in a filtered maceration of nut-galls, the words GENERATIO SPONTANEA. The dish was then covered with a glass plate, and kept at a mean temperature of 24° C. for four days. At the end of that time the words which had been written appeared in bold relief and of a black colour, owing to the growth of an *Aspergillus* bearing black capsules on cylindric non-articulated stems. The reasoning is thus expressed. The germs of this fungus could not have entered with the paste, for this had fully boiled, and experiment shows that the *Aspergillus* spores are totally disorganised by a temperature below that of boiling water; besides, the spores are too large to have escaped direct observation. They could not have entered with the gall-maceration, because this had been filtered, and microscopic examination demonstrated their absence. They could not have entered with the air, or why should they not have covered the whole surface of the paste and not merely those portions which had been moistened by the gall-maceration? It is scarcely necessary to point out how subsequent investigation has invalidated every one of these positions. But the growth of this fungus presents singular advantages for experimental investigation. Its course of development is regular and uncomplicated, and its prominent characters render it very easy to be recognised.

Upon a layer of flour-paste contained in three flat earthen dishes the following solutions are painted in broad bands:—1. Filtered maceration of nut-galls. 2. Brewer's yeast. 3. Syrup of currants. 4. Claret. The surface of one (B) was washed with 5 drachms of a one per cent aqueous solution of carbolic acid and then a glass cover was applied. Before a cover was applied to C, a piece of linen imbibing carbolic acid was affixed to it so as to give off the vapour. A, also covered with a glass, was left unchanged.

FIG. 1.



Aspergillus (seventh day).
In experiment strictly parallel, in atmosphere containing carbolic acid; there was no vegetable growth whatever.

After two days feathery fungi appeared on the surface of A; B and C remaining, so far as the eye could detect, uninfluenced. On the eighth day the whole were submitted to microscopic examination. The maceration-of-galls band of A presented multitudes of long, jointed filaments bearing on their summits capsules of globular form, containing multitudes of blackish sporules, the *Aspergillus primigenius* of Pouchet. Large spores of the *Aspergillus* were scattered over the whole field, and the capsules were shedding sporules in all directions (see Fig. 1).

The same layer in B (very weak *solution* of cabolic acid) showed no trace of *Aspergillus*. But it was not destitute of evidence of vegetable organisation and growth. Small spores were seen less than one-fourth the size of those of the *Aspergillus* as well as some penicilliums, mostly short and imperfect, but a few branching.

The same layer in C (vapour of carbolic acid) showed, in nearly its whole extent, no evidence of organisation;

* At a future day, I hope to have the results of more experiments upon this point."

but, at one spot,* there were seen cellular stems branching, and terminating in globular, oval, or truncated apices, the *Aspergillus polymorphus* (see Fig. 2). The other layers in A presented but little special variations. Feathery penicilliums were seen in almost every spot, the area where the wine was applied chiefly being occupied by round white dots, which proved to be aggregations of minute spherical spores. Penicilliums were abundant everywhere—perhaps chiefly on the surface of the red currant syrup. B and C also showed some minute sporules with penicilliums exceedingly less frequent than in A.

The glass covers were now re-applied, but not luted, so that air freely circulated over all the surfaces. In A, growth proceeded with great rapidity. The generation of *Aspergillus* died, and was succeeded by green mould and fine penicilliums. After a few days, maggots appeared.

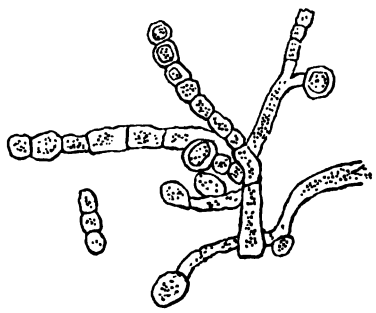
On the 23rd day, microscopic examination showed in—

A (unchanged): Myriads of sporules; dense bands of penicillium fibres; abundant animalculæ.

B (carbolic acid, 1 per cent solution): A few fibres of penicillium; less frequent minute spores; oval cells (*acetic ferment*).

C (carbolic acid vapour): No spores nor fibres, excepting on the *yeast*-band, which showed abundant yeast-cells unchanged, and just as when first applied to the surface; no growth whatever.

FIG. 2.



Aspergillus polymorphus. Drawn by aid of camera lucida.

The chief teaching of this experiment, concerning the action of carbolic acid in very weak solution and in vapour, appears to be the following:—

As regards the development of the specific fungus, *Aspergillus primigenius*: Complete prevention in both cases.

As regards the development of the fungoid organisms: Very marked repression, but not complete prevention in all cases.

Comparative action of (1) weak solution of carbolic acid in direct contact with materials for developing fungoid organisms, and (2) carbolic acid present in the air supplied to such materials: The latter by far the more powerful means of repression.

Expt. 3.—The materials were prepared for the development of the *Aspergillus primigenius*, and the measures were repeated with more stringent precautions against the entry of non-carbolised air.

The boiling paste having been poured into a flat dish, two glass covers—the one containing, in its interior, a small quantity of carbolic acid, dropped from crystals melted by heat, and allowed to solidify at the upper part of the glass, the other untouched—were taken; these were then inverted over and imbedded in the paste, and placed aside in a warm place. At the end of six days the results were observed.

Beneath the glass cover containing the carbolic acid (which, of course, could only have acted, by reason of its volatility, upon the contained air) there was no evidence of any organism whatever. Careful examination showed only minute granules, which aqueous solution of iodine coloured violet, and which were no doubt starch.

Beneath the glass cover containing no carbolic acid, there was exuberant growth of *Aspergillus*, filling up the whole space between paste and glass, its black capsules seen by the thousand, and its spores scattered in all directions.

This was many times repeated with always the same result.

The conclusion may be briefly summarised—

Atmosphere supplied to prepared soil { A, containing no carbolic acid. B, containing carbolic acid.

Result { A, abundant vegetation. B, no vegetation.

Expt. 4.—It seemed advisable to compare the action upon the air of various volatile media and chemical bodies under precisely similar conditions. The paste and gall-maceration were prepared, and over it, within precisely similar glass covers, the agents hereafter named were suspended. The results are expressed in a tabular form. The order expresses the restrictive power over the appearance of fungoid organisms possessed by the various agents, from the feeblest to the strongest.

Order.	Agent employed.	Appearances on fifth day.	Subsequent appearances, air being admitted.
1.	Air unaltered.	Abundant growth of black capsules, *Aspergillus*.	*Aspergillus* completely filled the vessel.
2.	Chloride of lime.	Fibres of penicillium.	This result was unlooked for; for, by an accident, the chloride of lime had actually fallen upon the prepared soil. Yet, in and amongst its particles were developed growing fibres of penicillium.
3.	Sulphurous acid.	—	Soon after exposure to air, abundant and rapid penicillium growth.
	Ammonia.	—	Abundant penicillium growth.
	Ether.	—	Small island of mould appeared, with abundant penicillium; afterwards, a few *Aspergilli*.
6.	Chloroform.	—	After exposure many days, *Aspergilli* began slowly to appear.
7.	Camphor.	—	After many days, penicillium slowly developed and gradually covered the surface.
8.	Iodine.	—	—
	Creosote.	—	—
	Phosphorus.	—	—
	Carbolic acid.	—	—

The results of this experiment show that many volatile bodies have the power of preventing the appearance of fungi, when present in the air which surrounds the soil upon which these, under ordinary circumstances, grow luxuriantly. The degree and the persistence of the influence of the various volatile media vary, however, considerably. Some, as ether, sulphurous acid, and ammonia, whilst effectually checking development, while they are actually present in the atmosphere, leave when they are volatilised, or during their volatilisation perhaps, favourable conditions for growth.

Chloroform and camphor leave each a most persistent effect. Some act so persistently that no organism appears at all; that is to say, the paste dries up gradually to a yellowish transparent cake, resembling dry gelatine, and presents no evidence of organisation whatever. For this persistency of effect no agent has been found so powerful as carbolic acid.

There is a further lesson to be learnt from this experi-

* It was probable that the glass cover had not been perfectly luted at this point, consequently the air was imperfectly charged with carbolic acid vapour.

ment. It appears at least to show that the chemical constitution of a volatile medium affords no indication of its energy in preventing the development of fungi. What agent could be expected more profoundly to alter the chemical atmospheric conditions than chloride of lime? Its power as an oxidiser, and collaterally a deoxidiser of aqueous vapour, requires no comment. Yet it was precisely this that was inferior to *all* the other media, many of which could be shown to exert no perceptible *chemical* influence in restraining the manifestations of vitality. The observation, however, agrees with that of Hallier, who found mycoderms, vegetating fibres, and oidium forms in the presence of chlorides of the alkalies and alkaline earths.

Expt. 5.—In some of the experiments before recorded the results seem to show that there was less evidence of organisation in a putrescible fluid when a toxic agent was mingled with the air supplied to it, than when the toxic agent was mingled with the fluid itself. This appeared so important as to require further investigation; for it might have a very strong influence in determining the truth between the two theories. For if the doctrine of spontaneous evolution were true, it would, surely, be more probable that the action of any chemical or poisonous agent in repressing the manifestations of life would be most pronounced when mingled with the particles whence vital evolution was proceeding, and least so when only mingled with the atmosphere with which the fluids were in relation. On the other hand, if the germ theory were true, it would be more likely that there would be less fertility when the repressive agent was absent from the fluid and present in the superincumbent air, as the toxic agency would be directly exerted upon the air-germs.

A series of stoppered glass bottles of two ounces capacity was obtained; to the stoppers of some of them were fixed small pieces of sponge. The bottles were then each one-quarter filled with filtered infusion of turnip. Equal quantities of the agents hereafter named were then in the one instance added to the fluid, and in the other dropped upon the sponge so as to become volatilised into the air contained in the bottle. After seventeen days, during which the unmodified infusion of turnip passed through its various stages of putrescence, developing, first, vibrios and bacteria; secondly, fungus spores; thirdly, branching penicillium, which bore abundant fructification, the infusions were examined with the following results:—

Sulphurous acid (1) in the fluid: Abundant vibrios and bacteria in all parts; at the surface innumerable leptothrix chains and fungoid fibres.

Sulphurous acid (2) in the air: Vibrios and bacteria in fluid; on the surface not a trace of a fungoid spore or organism.

Ammonium hydrate (1) in the fluid: Vibrios and bacteria in fluid; on the surface, mass of density-interlacing penicillium, and multitudes of spores.

Ammonium hydrate (2), in the air: Vibrios and bacteria in the fluid; on the surface, no trace of fungoid organism.

It seems difficult to reconcile these results with any other view than with that of the air-containing fungoid spores, which were killed in the presence of a volatile agent which acted as a direct poison upon it. Vibrios and bacteria, whose germs probably exist intermingled with every drop of the liquid, were alike abundant under both conditions, the poisonous agent being too weak to influence them as it was too weak to influence the fungi which developed when the air did not contain the volatile agent.

From the convergence of many methods of investigation and modes of thought, it seems, therefore, that the germ theory presents the strongest claims for acceptance. It suggests that beyond the confines of the visible world there is probably a world of living things almost inconceivably minute, but possessing varying characteristics. Into this world of beings yet unseen it will be the province of science yet to penetrate.

IMPROVED METHOD FOR THE

DIRECT QUANTITATIVE ESTIMATION OF IRON IN THE STATE OF A PEROXIDE SALT

BY MEANS OF HYPOSULPHITE OF SODA.

By M. A. C. OUDEMANS, jun.

DR. SCHERER was the first to propose the estimation of iron as peroxide, by means of hyposulphite of soda to be added in aqueous solution to the solution of the ferric iron salt until a violet colouration ceased to be produced.* Dr. F. Mohr pointed out that this method was inaccurate, inasmuch as that, at the moment the reaction appeared finished, there was already an excess of the hyposulphite of soda added, which cannot be well estimated, because it is decomposed by the free acid of the iron solution, owing to the absolute necessity of applying heat. MM. Kremer and Landolt tried to remedy this defect by the addition of acetate of soda to the iron solution in hydrochloric acid, the effect of which addition would be the setting free of acetic acid, which does not decompose hyposulphite of soda, and made it possible to estimate any excess of that latter salt, after the reduction of the sesquioxide of iron had taken place, by means of a solution of iodine. By a lucky incident, I have found the means of executing the direct estimation of peroxide of iron, in one and the same operation, without the necessity of previous reduction of the iron; and my method leaves nothing to be desired as regards its accuracy. Before I describe this method, I will pay some attention to the reaction of hyposulphite of soda upon a solution of sesquioxide of iron containing free hydrochloric acid. Hyposulphite of soda is readily decomposed by all mineral acids, even when they are largely diluted; and there is no difference in this respect, whether the acid be poured into the saline solution or the latter into the acid. But, when hydrochloric acid is added to a not too concentrated solution of a persalt of iron, and there is next cautiously added to that solution a solution of hyposulphite of soda, care being taken to avoid an excess of the latter, no sulphurous acid is given off; neither is any sulphur precipitated when the operation is conducted in the cold, since the hyposulphurous acid is, under these conditions, converted into tetrathionic acid—

$$2S_2O_3Na_2+Fe_2Cl_6+2HCl=S_4O_6H_2+4NaCl+2FeCl_2.$$

When some chloride of barium is added to a solution of perchloride of iron thus reduced, it is easy to see that not a trace even of sulphuric acid is formed. It is true that, when the fluid before alluded to is boiled, even if it contains no excess of hyposulphite of soda at all, the free tetrathionic acid is decomposed, and that chloride of barium will detect sulphuric acid; but the ensuing precipitate of sulphate of baryta is, according to my experience, exceedingly small, and out of all proportion with the total quantity of tetrathionic acid. I have, moreover, found that, even when the liquid is cautiously heated, it is not quite possible to obtain a correct estimation of the quantity of peroxide of iron by means of hyposulphite of soda, sulphocyanide of potassium being used as a reagent to indicate the end of the operation; yet the results I obtained were better than I at first expected, being only about from 2-100ths to 6-100ths too high.

The use of the following method eliminates, I am happy to say, all the defects of this method, which thus becomes available for the correct, ready, and easy estimation of the peroxide of iron in an acid solution:—I add to the iron solution, which may even contain a goodly excess of free chlorhydric acid, one or two drops of a solution of any salt of oxide of copper, and, next, as much of a solution of sulphocyanide of potassium as will suffice for imparting to the iron solution a deep red colour (for this purpose, I take from 2 to 5 c.c. of a solution of this salt at 1 per cent). I next pour from the burette the solution of hyposulphite of soda, whereby it will be seen that the well-known violet

* *Zeitschr. f. Anal. Chem.*, vol. i., p. 214.

colouration which ensues temporarily when solutions of pure iron and hyposulphite of soda come into contact does not, in this instance, make its appearance; but the red colouration, due to the sulphocyanide, gradually fades away by the addition of the hyposulphite (this decolouration is especially very marked where the liquids meet each other.) At first, the addition of the hyposulphite of soda solution may be made freely; but, when a certain quantity of that fluid has been added (care being taken to stir the iron solution well), it is necessary to add the hyposulphite drop by drop, and to wait a few seconds before a drop more is added. With a little practice, the operator soon learns when the end of the operation is about to be reached. At last, the liquid becomes as colourless as pure water, provided not too much of the copper solution has been added. The iron solution may be heated to 40°, not only without any danger, but with the decided advantage of accelerating the reaction, especially towards the end of the operation, which, however, whether heat be applied or not, can be performed in a few minutes.

The copper salt is to be considered as the cause of the reduction of the iron, it being my opinion that the reducing action of the hyposulphite of soda is first exercised upon the salt of copper, which, in its turn, reacts upon the iron salt; and the former appears to undergo, alternately, reduction and oxidation, and thus to aid the reaction and to play a somewhat catalytic part. The quantity of copper salt required is very small indeed, because I have seen even that so small a quantity as ¼ of a milligrm. of crystallised sulphate of copper exerts a marked effect; I also found that other substances, among them nitric acid, exert an analogous action, but also disturb the regularity of the process. When the iron solution has become quite colourless, the cupric salt is, in its turn, permanently reduced to a cuprous salt; and, if the cupric salt were not added in too small quantity, there is, after awhile, a whitish precipitate of subsulphocyanide of copper formed. I am not aware (and, therefore, call attention to this *en passant*) whether anyone has pointed out how the reduction of cupric to cuprous salts is brought about by hyposulphite of soda. My experience has taught me that, by this reduction, tetrathionic acid is also formed; and if I admit, as is done by most chemists, the formation of a double hyposulphite of soda and of suboxide of copper, this reaction may be formulated as follows:—

$$4S_2O_3Na + 2SO_4Cu = 2SO_4Na_2 + S_4O_6Na_2 + S_4O_6CuNa.$$

Returning to our subject, I state, in the first place, that my large experience has proved to me that the use of the sulphocyanide of potassium as an indicator is, notwithstanding all that has been alleged against its use in this process by M. Mohr, perfectly safe, and not in the least inconvenient. As regards the concentration of the iron solution and the quantity of free acid, the operator has a great latitude in this mode of operation, but it will be clear that too great excesses are to be avoided. As regards the accuracy of this method, I shall communicate some results, but desire to observe, first, yet, that the estimation of iron by this method is not interfered with by the presence of the salts of alkalies, strontian, lime, magnesia, protoxide of manganese, and alumina; neither do the salts of nickel, cobalt, or copper interfere, provided they are not present in so large a quantity as to become a hindrance by the colours they might impart to the iron solution. The test solution of hyposulphite of soda (at 1-10th of normal standard) I prepared by dissolving 24·8 grms. of the perfectly pure salt in 1 litre of water, taking care to test this solution repeatedly with re-sublimed iodine. I also dissolved 24·1 grms. of iron and ammonia-alum in 500 c.c. of water, and added some c.c. of concentrated hydrochloric acid. Each c.c. of this solution ought to correspond to 1 c.c. of the solution of hyposulphite of soda. I found—

Iron solution.		$S_2O_3Na_2$.	Iron solution.		$S_2O_3Na_2$.
10 c.c.	=	10·0 c.c.	100 c.c.	=	100·50 c.c.
40 ,,	=	40·0 ,,	25 ,,	=	24·95 ,,
20 ,,	=	19·9 ,,	25 ,,	=	25·00 ,,

I dissolved 5·6168 grms. of fine piano iron wire in hydrochloric acid, to which some chlorate of potassa was added; the liquid was boiled a sufficiently long time to decompose any excess of chlorate which might be present, and the bulk of the liquid was next brought to 2 litres. Taking for granted that the metal employed contained 99·7 per cent of pure iron, 2 c.c. of the solution ought to correspond to 1 c.c. of the hyposulphite solution. I found—

Iron solution.		$S_2O_3Na_2$.
20 c.c.	=	10·00 c.c.
40 ,,	=	20·05 ,,
60 ,,	=	29·95 ,,
100 ,,	=	50·10 ,,
200 ,,	=	100·05 ,,

The following experiments were made so as to preclude any preconceived notion about the quantity of iron taken for experiment, care being taken to estimate the quantity of iron only after the end of the assays with the hyposulphite:—3·576 grms. of iron and ammonia-alum were dissolved in water, some hydrochloric acid added, and the solution made up to 300 c.c.; the average result of three assays was, that the quantity of iron, Fe_2O_3, found was 0·5932, and the quantity calculated 0·5934. In another experiment of the same kind, with 4·0200 grms. of the same salt, also made up to 300 c.c. solution, the quantity of iron found was 0·6656, and the calculated quantity 0·6672. 2·6055 grms. of the same salt, treated as above mentioned, and made up to a solution of 250 c.c., gave, as result, 0·4300 of Fe_2O_3 found, and 0·4325 of the same calculated. 0·4980 grms. of fine piano-wire were dissolved as already stated, in chlorhydric acid, and the liquid made up to 300 c.c. 100 c.c. of this solution required, for three assays, respectively, 29·8, 29·6, and 29·6 c.c. $S_2O_3Na_2$; the quantity of iron, Fe, found amounted, on average of the three experiments, to 0·4985, while the quantity calculated (taking the wire to contain 99·7 per cent of metal) amounts to 0·4965.

Influence of the Degree of Dilution.—25 c.c. of standard solution of Fe_2Cl_6 at 1-10th normal required 25 c.c. $S_2O_3Na_2$ at 1-10th normal; 25 c.c. of the same solution of iron, diluted with 50 c.c. of water, required 25·05 c.c. of the same hyposulphite solution; 10 c.c. of the iron and 100 c.c. of water required 10·0 c.c. of the hyposulphite solution. (Under these conditions, the experiments require more time.) In order to test whether a more concentrated solution presented any difficulties, the following experiments were made:—I dissolved 0·1953 grms. of piano-wire in hydrochloric acid, added chlorate of potassa, well acidified the fluid, boiled, and made up with water to 20 c.c. I next added the hyposulphite standard solution, of which I used 34·9 c.c., giving as result, Fe—found, 0·1946; calculated (at 99·7 per cent, as above), 0·1954. 3·3680 grms. of sulphate of iron and ammonia (ammonia-alum) were dissolved in a small quantity of water, and the iron oxidised with chlorate of potassa; HCl was next added in excess, and the liquid boiled, and afterwards made up to 150 c.c. The quantity of standard hyposulphite solution required was 85·7 c.c. iron, Fe—found, 0·4799; calculated, 0·4811.

Influence of the Free Hydrochloric Acid.—25 c.c. of the Fe_2Cl_6 standard solution at 1-10th normal and 1 c.c. of strong HCl required 25·0 c.c. $S_2O_3Na_2$.

Same iron solution. c.c.		Strong HCl. c.c.		Hyposulphite solution (standard). c.c.
25	and	2	required	25·0
25	,,	3	,,	25·0
25	,,	4	,,	25·2
25	,,	5	,,	25·0
25	,,	6	,,	25·1
25	,,	8	,,	26·1
25	,,	10	,,	26·2
25	,,	15	,,	26·5

[NOTE.—We must not neglect to state here that, according to M. O. Popp (*Zeitschrift für Chemie von*

Beilstein, No. 11, 1870), the addition of a few drops of a solution of a salt of copper, as directed by the author of the paper above mentioned, is unnecessary, M. Popp having found that the reaction and operation succeed perfectly if the iron solution is heated to 40° without any addition of a salt of copper.—*Ed. C. N.*]

ON FERMENTATION.*

By Professor A. W. WILLIAMSON F.R.S.

(Continued from p. 248).

Lecture I.

I ought, however, in justice to the wonderful process which I alluded to, to give you two or three other particulars regarding it. I showed that sugar is broken up by the ferment into these products, but no case is known of pure sugar—and when I say pure sugar, I mean sugar in the purest form in which we have it—being decomposed by yeast. If you were to put some ready-made yeast—thriving, growing, yeast—into a solution of chemically pure sugar, some of your yeast would decompose, some of it would resolve itself into other products, and other parts of it would be absorbing those products which are present in the liquid, and whenever the process is to be carried on advantageously and rapidly, it is customary to add some saccharine liquid—some other substance capable of nourishing the yeast. When I want good fermentation I do not take water to dissolve my sugar, and put yeast into it, but I boil some of this malt, which is one of the best materials for the purpose, in water, and take a decoction of malt, or decoction of yeast, and put the sugar into it. In such a liquid there are several bodies which we know; and I may safely say that there are a great many others which we do not know, and there is no doubt that their presence is of considerable importance to the chemical change which takes place. There are substances which I shall presently have occasion to show you and to speak of, formed by the germination of the grain, by the formation of the malt, which are related somewhat to this body which I have here. This was some pure wheat flour—every kind of flour would not do—and it is supposed that some people mix other materials with flour. It was kneaded up with water, pressed together, and, whilst the pressure was being continued, water was allowed to trickle over it. I have in another bottle some of the water that flowed over it. There is a white substance deposited from this water, which is commonly known and much used by the name of starch, and starch is, in its chemical composition, first cousin to sugar; it is a substance which passes over very readily into a kind of sugar by a process I shall presently have occasion to allude to. But the little ball of flour while being kneaded had the starch washed away from it, and I have left, as the result, a substance which is commonly known by the name of gluten. If I were to describe it in chemical language, I should say it is something like flesh, or the muscular fibre of animals, for, in chemical composition, it approaches very nearly to that. When barley is malted, and kept in a warm place for some time, the grains begin to germinate and decompose, and some bodies are formed from this gluten, which is partially broken up. The malt contains also some sugar made from that starch—grape sugar, as we usually call it.

If we had only those extreme cases, I really do not know what we should do. If we had in our science one set of bodies which appeared so constantly to act at variance with the general laws which the others obey, I think we could not call chemistry a science. I have taken two or three examples to show you the definite proportions which we find to regulate the ordinary process of combination. I might have taken thousands, but the point is that this law does not appear to apply at all to these chemical changes which we call fermentation. One of the active substances in fermentation is being formed, it is increasing, not disappearing at all, and the contradiction is so strong and manifest that the only way out of the difficulty will be to do something of the kind which I was speaking of some time ago, that is to say, see if we cannot get some intermediate facts which will serve to connect the extreme ones; to see if we cannot get at first something between the two classes, and then try to get some further links between them. There are processes of chemical change—I will not call them processes of fermentation, for I do not know whether they are, but which are analogous to it, and some of them are very interesting and very beautiful. I have here a substance called amygdalin, made from bitter almonds. It is a bitter tasting substance, and consists of four elements which it is not necessary that I should name. In this other bottle I have a paste formed of sweet almonds, which have been crushed with a pestle and mortar, and I will put some of it into the warm distilled water in this flask. Into the mixture I will put some of this amygdalin. If I were to leave it without that addition, there would be very little change; the substance would gradually subside, but there would be no product given off in the way you will presently see. After letting it stand for a few minutes, I will pour some of the mixture into an open vessel, and we shall be able, without difficulty, to perceive a fragrant smell, which is due to the presence of a liquid of which I have a quantity here, a substance known by the name of oil of bitter almonds. If we were to perform the same experiment on a large scale, and macerate some of this amygdalin with almond paste, put them together with warm water, distil the mixture, and collect what comes over, we should find that water would pass over, and with it would be a few drops of oil of bitter almonds, and the amygdalin would be decomposed in the process. There is in the sweet almond paste a substance which I cannot describe in better terms than by comparing it to that gluten which I showed you just now. It is very similar to it in its composition, and by the contact of this, the synaptase, as it is called, with the amygdalin the elements of the amygdalin are broken up into several products; one of them is the oil of bitter almonds, another is prussic acid, which generally accompanies the oil, the third is a variety of sugar of the kind which is called grape-sugar, and there is probably also some formic acid. Here we have the breaking up of a complex body, amygdalin, into several simpler bodies by the action of the body called synaptase; but there is not in the process, as far as I know, any living organism at work. There is a substance which is somewhat similar to these living organisms, but there is no organised structure, as far as our knowledge goes at present.

Take another experiment. I have here something which is not a *blanc mange*, although it looks something like it; it was made by boiling potato starch with water. We let it cool, and then turned it out; some was put into a flask with two or three ounces of crushed malt. It was warmed to a temperature of 60° C. for about an hour; there was no boiling. The substance was then squeezed through a cloth to keep back the husks of the malt, and here is the liquid which ran through. It is perfectly liquid, and its consistency is entirely different from that of starch, from which it was made; it is quite sweet to the taste, and there is a large quantity of sugar in it. There is also another body which we class with the sugars; that is, there is in this liquid a good deal of a kind of gum, which we call dextrine, which would easily pass into sugar. The starch, when it was being converted by the action of the malt into those soluble bodies, did no, so far as we know, break up into simpler substances; the process was of a different kind. It assimilated the water—the starch combined with the water, and at the same time divided itself, some of it forming one and some the other product. Here, also, there was not, as far as my know-

* The Cantor Lectures. Delivered before the Society of Arts.

ledge goes, any ferment, or any organised cells in the liquid. If they were present it was an accident, and was not essential to the change which took place. I am the more confident in saying that no ferment was there present, for we can get, and we very often do get, precisely the same formation of starch without any malt at all. If, instead of warming some of that starch with the infusion of malt, I had mixed it with a little—about 5 per cent—of that strong sulphuric acid, and had heated it, it would have been dissolved almost like sugar in water. In fact, there are now in Germany, and also in England, manufactories in which starch is converted by the action of dilute sulphuric acid, into grape-sugar, and the same change which we get by organic substances—that is the point—we also get by the action of this mineral acid.

Another change of the same kind I may mention, especially as the subject of it is in itself interesting. I have here a substance which people have been accused of making for the purpose of adulterating quinine. It is made from willow bark, and is believed to possess febrifuge qualities, so that there was some little excuse for what I have mentioned. This substance is called salicine, and when heated with dilute sulphuric acid, in the same way as the starch when so heated, was converted into sugar and dextrine; this salicine breaks up in a way which I might compare with that in which some bodies are broken up by fermentation.

Another case of same kind is afforded by tannin, a substance extracted from gall nuts, and which is present in oak and many other barks. It is used for combining with gelatine, which is the principal constituent in hides, to form leather. If we dissolve this tannin in water, and leave it in an open vessel, it will get mouldy; nd if you examined it a some time you would find none of it left. It would all disappear, just like sugar in the process of fermentation, and in place of it you would find, in that particular process, a body which you might easily crystallise out from the liquid, and which I have here; it is called gallic acid. It is a body resembling tannin in some respects, for instance, in the property of forming, in combination with iron, a dark substance, which is used in suspension in water, for writing ink. But it will not do to form leather in combination with gelatine. If you left the tannin in an open vessel, it would decompose, and there would be left gallic acid, and some other material which was formed at the same time would have disappeared. By boiling tannin with dilute acid, we get the process performed more regularly. Upon boiling some tannin with dilute sulphuric acid, you would find that water would be taken up by it, the tannin would combine with water, and it would break up into sugar and gallic acid, the process being exactly like that which I mentioned in the case of salicine. There is a most direct analogy between the process of breaking up which sulphuric acid effects upon tannin and that of fermentation. I ought to say, when telling you of the decomposition of the tannin, that it is effected by little animal organisms present in the liquid, and it appears that they are the agents of the transformation.

(To be continued).

ON THE

PRECIPITATION OF ANTIMONOUS SULPHIDE FROM BOILING SOLUTIONS.

By STEPHEN P. SHARPLES.

In the precipitation of antimonous sulphide, I have found it of very great advantage to employ the following process:—Into the solution, containing, as usual, tartaric and free chlorhydric acid, a current of sulphydric acid gas is to be passed, the liquid being, during the passage of the gas, gradually heated to the boiling-point. The boiling is then to be continued for fifteen or twenty minutes, the current of gas passing uninterruptedly until the voluminous sulphide has become a dense granular powder occupying but a small portion of the original volume of the sulphide. The sulphide may then be washed with great facility, and dried upon a sand filter at 200°—300° C. All the determinations of antimony made in the laboratory of the Lawrence Scientific School for some years have been executed in this manner, the results leaving nothing to be desired. Arsenious sulphide does not become granular and dense under the same circumstances. In this connection, I may be permitted to mention that the sulphides of nickel and cobalt, when precipitated from boiling solutions in the manner recommended by Professor Gibbs some years since, should be filtered off, and washed immediately after precipitation. In this manner, there is no oxidation upon the filter, even during the drying of the precipitate. But, if the sulphides are allowed to stand in the solution from which they have been precipitated, for even a few hours, they will usually oxidise upon the filter during the washing.—*American Journal of Science.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 17th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following papers were read:—

"*Mineralogical Notices*," by Prof. MASKELYNE and Dr. FLIGHT. The contents of this communication were:—

1. *On the Formation of Basic Cupric Sulphate.*—In 1867, M. Pisani described a mineral which he supposed to be the Woodwardite of Mr. Church. The substance, however, is not the latter mineral. It had previously been examined in the Laboratory of the British Museum, and the results sufficiently tallied with those of M. Pisani to identify the mineral. It can be divided into an inner layer and an outer crust. The first consists of—

Copper oxide	24·561
Alumina	23·063
Calcium oxide	0·086
Magnesium oxide	0·749
Sulphuric anhydride	6·775
Silicic anhydride	6·689
Water	38·528
	100·451

The crust is thus composed—

Copper oxide	10·255
Alumina	27·250
Calcium oxide	1·403
Magnesium oxide	6·183
Sodium oxide	0·643
Sulphuric anhydride	2·438
Silicic anhydride	7·530
Carbonic anhydride	0·528
Water	43·969
	100·199

These numbers give us but little insight into the constitution of the mixed minerals. The only interest they offer is in the light they seem to throw on the possible modes of the formation of native basic cupric sulphates. The actions of solutions of magnesium or calcium sulphate on malachite may terminate in the production of Langite. An experiment in the Laboratory showed that an insoluble cupric sulphate and acid magnesium carbonate were actually formed.

2. *Opal from Waddela Plain, Abyssinia.*—Mr. Markham presented to the British Museum some remarkable speci-

mens of green opal from the above locality. Its analysis yielded the following numbers:—

Silicic acid (soluble)	90·562
Silicic acid (insoluble)	2·049
Water	5·656
Iron peroxide	0·933
Manganese peroxide	trace
Calcium oxide	0·137
Magnesium oxide	0·311
	100·648

3. *Francolite, Cornwall.*—Its analytical numbers point to the formula—

$$\left.\begin{matrix}5[3Ca_2(PO_4)]\\CaCO_3\end{matrix}\right\} + 2CaF_2.$$

It is, in fact, a fluor-apatite in which one equivalent in every six of the calcium phosphate is replaced by carbonate. The crystallography of this mineral seems also to point to its not being ordinary apatite, and, in fact, to its not being the same mineral as the original Francolite from Wheal Franco.

4. *Epidote and Serpentine, Iona.*—A pebble, in which a green mineral traverses bright red felspar and quartz in veins, was sent by the Duke of Argyll to the British Museum. Its analysis leads to the view that it consists of a lime epidote with some 23 per cent of quartz, the former mineral having the following constitution:—

$$3[2CaO,SiO_2] + 2[2(\tfrac{2}{3}Al\tfrac{1}{3}Fe)_2O_3,3SiO_2].$$

Two specimens of serpentine, of the same locality, gave the general formula—

$$3R''O,2SiO_2,2H_2O,$$

where R represents, in one case, Mg with a little Fe and Ca; in the other, Mg with nearly one-fifth of its equivalent of an equal mixture of Fe and Mg.

5. *Vivianite.*—Two kinds of this mineral were found in an unknown Cornish locality. The one, of a pale blueish tint was ascertained to consist of—

Iron protoxide	42·709
Iron peroxide	1·126
Phosphoric anhydride	28·526
Water	28·984
	101·345

The other variety, of a brownish colour, gave on analysis—

Iron protoxide	42·889
Iron peroxide	0·801
Phosphoric anhydride	28·792
Water	29·433
	101·915

Both proved, therefore, to be octahydrated ferrous orthophosphate, $3FeO.P_2O_5,8H_2O$, and the difference in the colours can only be ascribed to some minute difference in the degree of oxidation of the iron. The brown variety was enclosed in nodules of a dark blue earthy mass which was composed of:—

Iron protoxide	37·214
Iron peroxide	9·169
Phosphoric anhydride	23·897
Carbonic anhydride	5·162
Water	23·871
Silica	0·811
Organic matter	0·826
	100·920

These numbers may be interpreted as representing 5 equivalents of octahydrated ferrous orthophosphate with 1 equivalent of octahydrated diferric phosphate, mixed with four equivalents of ferrous carbonate. The British Museum possesses some fine crystals of vivianite from Fernando Po, the chemical examination of which gave as results:

Iron protoxide	38·501
Iron peroxide	5·083
Phosphoric anhydride	27·802
Water	28·326
	99·712

This specimen stands intermediate between the blue and brown crystalline varieties on the one hand, and the blue earthy mineral on the other.

6. *Cronstedtite.*—The analysis of this mineral presented considerable difficulties, inasmuch as it was extremely difficult to free it from the substances associated with which it is found.

The cronstedtite in question possesses an unusual interest from a crystallographical point of view, being one of the best defined types of hemimorphism.

7. *Pholerite.*—This mineral, derived from India, is of a pale flesh-white, penetrated in several places by patches and veins of a black mineral. An analysis of the flesh-white mineral gave the following results:—

Silicic acid	43·144
Aluminium oxide	41·073
Water	15·783
	100·000

Traces of iron and manganese oxides accompany the alumina. A new name was proposed for this mineral, but the analysis shows it to be nothing but pholerite.

Mr. Church observed that it was a matter of congratulation to have those beautiful specimens, which are stored in our magnificent national collections, investigated in so excellent a manner as the contents of the paper just read had shown.

The next communication was a note by Mr. Chapman, "*On the Oxides of Nitrogen.*"

In a paper read at the last meeting of the Chemical Society, Mr Chapman mentioned that he had quantitatively estimated nitric oxide by converting it into nitric acid and determining the latter by the production and weighing of the baryta salt. Objections were then raised as to the possibility of the completeness of such a conversion. Mr. Chapman now endeavoured to show, by referring to well-known chemical facts, that, whether N_2O_5, N_2O_4, or N_2O_3 be formed when NO is left with excess of oxygen over water, the final result must be the transformation into nitric acid. He, moreover, referred to the circumstance that the above-mentioned facts were accepted by Schloesing, by Playfair, and Wanklyn, as sufficient to found upon them the quantitative estimation of nitric acid. As to SO_2 being present in his experiments, Mr. Chapman found this by special researches to be of no consequence.

Mr. Harcourt reasserted that, on his passing nitric oxide into oxygen, he obtained, as result, nitric peroxide; when reversing this order, and passing oxygen into nitric oxide, a mixture of N_2O_4 and N_2O_3 seems to be formed.

Mr Chapman replied that the different results obtained by Mr. Harcourt and by himself were, in all probability, due to differences of the temperatures at which the respective experiments had been executed.

Professor Williamson took occasion of this repeated mentioning of nitric peroxide to remark that this compound may be viewed as

$$\left.\begin{matrix}NO\\NO_2\end{matrix}\right\} O;$$

i.e., as water in which the one hydrogen was replaced by NO, the other by NO_2.

The Society then adjourned to December 1st, when Mr. Perkin will read a paper "On some Derivatives of Anthracene."

GLASGOW PHILOSOPHICAL SOCIETY:

(Chemical Section).

The annual general meeting was held in the Society's rooms, Corporation Buildings, on Monday evening, the

21st inst., at eight o'clock. Mr. W. R. Hutton, Vice-President, in the chair.

Dr. Wallace, F.R.S.E., F.C.S., was unanimously elected President for three years, in room of Professor Anderson, whose term of office has expired.

Mr. John Ferguson, M.A. was appointed a Vice-President in room of Dr. Wallace.

Four new members of Council were elected in place of the four who retired by rotation.

The following is the present list of office-bearers:—

President—Dr. Wallace, F.R.S.E., F.C.S.

Vice-Presidents—Mr. Alexr. Whitelaw; Mr. W. R. Hutton; Mr. John Ferguson, M.A.

Members of Council—Mr. James Anderson; Dr. John Clarke; Mr. James Couper; Mr. John Ferguson, M.A.; Mr. W. R. Hutton; Mr. James Mactear, F.C.S.; Mr. P. M. Moir; Mr. T. L. Patterson, F.C.S.; Mr. E. C. C. Stanford, F.C.S.; Mr. John Sutherland; Mr. R. R. Tatlock, F.R.S.E., F.C.S., *Secretary*; Mr. Alexr. Whitelaw.

ROYAL IRISH ACADEMY.

THERE was a general meeting of this Society on Monday, the 14th, when the following papers were read:—

I. REV. MAXWELL CLOSE, "*On M. Delaunay's Views Relative to the Condition of the Interior of the Earth*,"

II. SAMUEL FERGUSON, LL.D., "*On the Difficulties Attendant on the Transcription of Ogham Legends, and the means of avoiding them.*"

The following recommendation of the Council was also adopted:—

"That Her Majesty's Government be memorialised to use their good offices in order to prevent, as far as possible, any injury during the present siege to the collections in Paris, which are universally acknowledged to be of inestimable value to Science, Literature, and Art."

LABORATORY NOTES.

SUB-PERMANENT MAGNETISM EXPERIMENT.

THE following experiment may be interesting or useful to some of your readers. The object of the experiment is to produce, in a few minutes, what Dr. Tyndall has named sub-permanent magnetism; and thus represent to a class *quickly* what is effected by the earth *slowly* in soft iron lying in the magnetic meridian, and subject to molecular disturbance from percussion or other causes.

The requisites for the experiment are—a block of cast-iron (wrought-iron might, perhaps, do) slightly magnetised, a bit of soft iron wire, a hammer, and a magnetic needle for testing the wire.

Expt. 1.—Lay the iron wire on the block, and hammer it lightly from end to end, for a few seconds. Presented to the needle, the wire will be found magnetised, showing distinctly strong N. and S. poles, produced by the S. and N. poles of the block.

Expt. 2.—Place the wire *reversed* on the block, *i.e.*, lay the N. pole of the wire on the N. pole of the block, and hammer as before. Tested again by the needle, the wire exhibits its poles reversed.

Expt. 3.—Lay the wire as in Expt. 1, and hammer; the original polarity is restored. Finally, by changing the position of the wire, the pole may be changed and re-changed as long as the wire lasts.

This experiment would seem to represent well the magnetising action of the earth. The block personates the earth with its magnetism, which is not less comparatively than that of the cast-iron. Were the wire to remain for a considerable time lying on the block, it would be magnetised. The hammering effects *quickly*, in the whole wire that molecular disturbance which is slowly and piece by piece produced in great masses of iron standing on the earth.—I am, &c.,

E. KERNAN.

Clongowes.

CORRESPONDENCE.

ATACAMITE.

To the Editor of the Chemical News.

SIR,—Under the head of "Notes and Queries," in your last week's impression, atacamite is mentioned as a "rare mineral; new to Britain." This is an oversight, as you will be quite well aware that it has long been found at St. Just, Cornwall, and that its variety, Botallackite, is only known as a product of the Botallack mine in that county.—I am, &c.,

THOS. C. ARCHER.

Edinburgh Museum of Science and Art,
Nov. 22nd, 1870.

THE RECENT DISCUSSION AT THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Although there was no doubt that nitric oxide in presence of an excess of oxygen, and of much water, and at moderate temperatures, passes totally into nitric acid, still, the recent discussion at the Chemical Society is hardly to be regretted. If it did not throw any light upon the scientific question—if the fact of such a change taking place was manifest to any one who consulted the common chemical text-books, and still more patent to those who had experimented for themselves—it, at any rate, was calculated to illustrate the curious incompleteness of our chemical education; or, perhaps, I ought to say, it illustrates the necessity of investigating some of the commonest and most elementary of chemical facts that have, somehow or other, been lost sight of.

In my eyes, criticism is one of the paramount needs of chemistry. One false fact, stubbornly maintained, is capable of closing the way to those generalisations which are the glory of science, and the sweeping away of one such false fact is, usually, a far greater service than the correct observation of a new one.—I am, &c.,

J. ALFRED WANKLYN.

PURIFICATION OF SYRUPS.

To the Editor of the Chemical News.

SIR,—I regret to have to trouble you with the following remarks, but I consider it a duty to do so.

You have published, in the last number of your interesting and valuable journal, a notice on a patent, taken by Dr. Seyferth, for the purification of syrups and molasses in the manufacture of sugar by a sulphurous acid solution.

I beg to state that I carried out the application of this acid in sugar refining so far back as 1850, and sold it to some sugar refiners, who employed it successfully to my knowledge, and no doubt are doing so at the present time.

Dr. Seyferth will find a notice of my process in the *Technologiste*, vol. xix., p. 478 (1858), and in the *Chemist*, vol. v., p. 344 (1858). There, it is stated that the application of sulphurous acid possesses two marked advantages for the sugar refiner—(1) "That it stops the fermentation of his hot liquors as they come out of the char-filters; and (2), when properly applied, it tends to prevent the

re-colouration of the liquors during their concentration in the vacuum-pan. In practice, I found that very successful results were obtained by adding 2 gallons of a saturated solution of sulphurous acid to 100 gallons of decolourised liquor as it left the char-filter, and was collected in tanks until pumped up or run into the vacuum-pan.'

In the same volume (same page), I also described a very simple and cheap mode of preparing hundreds of gallons (per day) of sulphurous acid.—I am, &c.,

F. CRACE CALVERT.

Royal Institution, Manchester.

MISCELLANEOUS.

Royal Institution of Great Britain.—The courses of lectures before Easter include eleven lectures by Dr. Odling, F.R.S., on "Davy's Discoveries in Chemistry;" four lectures by W. H. Channing "On the Progress of Civilisation;" three lectures by Professor Jowett, M.A., "On Socrates," and four lectures by H. O'Neill, R.A., "On the Spirit of the Age." Friday evening discourses, which commence on January 20th, 1871, are expected from Dr. Tyndall, Dr. Odling, Mr. E. J. Reed, Mr. James N. Douglass, Dr. Carpenter, Captain Noble, Professor Clerk Maxwell, Mr. J. N. Lockyer, Mr. W. Mattieu Williams, and Professor Max Müller.

Permanganate of Potassa against Coryza.—Although not exactly belonging to the subject matter usually treated in this paper, we think we may briefly call attention to the use of permanganate of potassa in very dilute solution (0·18 grms. = 1·67 grains to 60 grms. or c·c. = to about 2 fluid ounces) against coryza, cold in the head, attended with severe sneezing. Of the permanganate solution, some 20 to 60 drops are poured into a tumbler-full of water, and of this liquid every two hours a quantity of a table-spoonful is snuffed up the nostrils, and if there be any soreness of the throat, the same liquid is applied as a gargle. Dr. Franck, of Münich, states that he has prescribed this mode of treatment now for some years, and found it very efficient by curing the complaint in about from two to four days.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, September, 1870.

This number contains the following original papers and memoirs:—

Chemical Assay of Cements.—Dr. C. Bender.—This memoir has been written with the view of enabling parties somewhat acquainted with chemistry, but not professional chemists, to perform an analysis of cements—viz., so-called Portland and Roman cements. As an introduction, the paper gives a lengthy description of the physical qualities of cements; but it is clear (except that Portland cement of good quality exhibits, when seen under the microscope, a foliated structure, and that a yellowish brown colour is an indication of adulteration), that the outward aspect, specific gravity, and other properties of these substances must of necessity vary with the mode and materials of preparation. The chemical analysis is conducted in the following manner:—A quantity of from 1 to 3 or 5 grms. (according to the author, the quantity to be taken depends upon the accuracy of the balance the operator has at hand; but it is understood, at the same time, that the balance should be capable of turning, when loaded in each pan with 30 grms., with at least 1—2 milligrms.) is weighed off, and the hygroscopic water estimated by drying in an air-bath at 180°—200°. The water of constitution, and also the carbonic acid, are estimated by fusing another portion of the cement in a platinum crucible along with about four times its weight of previously fused and pulverised borax; the joint quantity of both these constituents, exclusive of the hygroscopic water, will not, on an average, exceed 3 per cent. For the estimation of the other constituents, a quantity of from 4 to 6 grms. is weighed off, and, after having been put into a beaker, hydrochloric acid, of about 1·104 sp. gr. at 15°, containing 20 per cent of anhydrous acid, and boiling at 110°, is added, and the vessel and contents first heated on a water-bath, and next evaporated to dryness. After the dry residue has been moistened with hydrochloric acid, it is left standing for twelve hours, water added, and filtered off, the residue on the filter being pure silica if the cement is well made. The filtrate and washings are diluted with distilled water to 1000 c.c.; and, of these, 300 c.c. are taken for the estimation of the alumina, oxide of iron, lime, and magnesia. For this purpose, the acid liquid is, first, as near as possible, neutralised with a solution of carbonate of soda; next, a solution of acetate of soda is added, and the liquid boiled, whereby basic acetate of iron and alumina and (in case phosphoric acid were present) phosphate of peroxide of iron are precipitated. This precipitate is collected on a filter, and, after having been washed, dried, ignited, and weighed, the estimation of the other constituents of the cement—viz., phosphoric and sulphuric acids, manganese, lime, magnesia, alkalies, and chlorine, is done by methods fully described in all works on quantitative chemical analysis; but, in addition to the process here alluded to, it is necessary to disintegrate and fuse, by well-known methods, a separately weighed portion with pure carbonate of soda.

Meteoric Dust among Snow.—Dr. A. Husemann.—This paper gives an account of a reddish coloured dust which fell along with snow in the Swiss canton Du Vaud in the winter of 1867. According to a calculation, made from experiments and observations conducted with care, the quantity of dust fallen over the entire surface of the canton amounted to about 1500 tons. The author examined the dust, as well as the snow which had fallen simultaneously. The water yielded by the snow contained a considerable quantity of sulphate of lime and organic matter, both of which are absent in ordinary snow-water, at least in Switzerland. The microscopical inspection of the dust proved it to contain minute particles of mica, felspar, quartz, and variously-shaped organic matter. After having been dried at 100°, and ignited, the loss amounted to from 20·8 to even 24 per cent for four different assays. The greater portion of this loss was due to the volatilisation of water of crystallisation and constitution, but nitrogenous organic matter was also found to be present. Of the residue after ignition, about half was found to be soluble in hydrochloric acid. This solution, which was only qualitatively tested, contained peroxide of iron, lime, alumina, magnesia, and sulphuric acid; the portion insoluble in acid, having been fused with a mixture of potassa and soda, was found to contain, beside a large quantity of silica, also alumina, oxide of iron, and lime. The dust, when treated with an acid, gave off carbonic acid largely. The author also quotes an analysis of so-called Orandust—that is to say, a dust carried across the Mediterranean to Europe, that dust being undoubtedly brought by wind from the Sahara Desert. The author found this dust to contain, in 100 parts—Silica, 54·85; carbonate of lime, 20·48; sulphate of lime, 0·41; carbonate of magnesia, 3·95; peroxide of iron, 4·25; alumina, 0·98; water, 2·34; organic matter, 3·90; chloride of sodium, traces. The author observes that this analysis is not complete, being short from 100 by about 8 per cent, this being due to the very small quantity of substance at the disposal of the operator.

Morphia from the Capita Papaveris Albi.—Dr. Vorwerk.—The author states that he has for some time past prepared morphia with good success from the almost valueless poppy-heads, which, when first exhausted with water, yield from the extract about 3-10ths per cent of the heads of morphia.

Alkaloids in Plants belonging to the Family of the Boragineæ.—Dr. Buchheim.—The author briefly states that, having found it stated that the extract of cynoglossum acts as a poison, in a manner similar to the American arrow poison, known as *curara*, he felt induced to try to extract, from various plants belonging to the family above named, an alkaloid. In this respect, he was only partially successful, by obtaining from the cynoglossum a body which, although not quite pure, exhibited properties which—as, for instance, alkaline reaction, precipitation by tannin, by phospho-molybdic acid, and chloride of mercury—proved it to be a compound akin to an organic alkaloid. This substance, for which the name of cynoglossine is proposed, was found to have a specific poisonous action on various animals.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 8, 1870.

This number only contains the following paper relating to physico-chemical and allied sciences:—

Researches on the Constitution of Phloretic Acid and on Sulpho-Hydrocinnamic Acid.—L. L. de Koninck.—In the first portion of this essay the author gives an account of his researches made for the purpose of verifying, experimentally, the hypothesis of MM. Glaser and Buchanan, who view phloretic acid as being normal ortho-oxyphenyl-propionic acid; but the author's experiments have not led to any direct result in this direction. The second part of this paper treats on sulpho-hydrocinnamic acid, which is prepared by dissolving hydrocinnamic acid in a mixture of strong sulphuric and fuming sulphuric acids, and heating to 125° for about an hour's time. The liquid is then poured into a rather large quantity of water; the hydrocinnamic acid which has not been converted into sulpho acid falls down as an oily liquid, which, after the fluid has become quite cold separates as a crystalline mass. The sulpho-hydrocinnamic acid is obtained pure, in free state, by means of the addition to the fluid, first, of some carbonate of baryta, and next baryta-water; and the hydro-

cinnamate of baryta is next carefully decomposed with just enough dilute sulphuric acid. Sulpho-hydrocinnamic acid thus obtained is a highly deliquescent, solid, crystalline substance. Its hygroscopicity is so great as to prevent its being obtained in sufficiently dry state for organic elementary analysis; but its composition, as deduced from the salts it forms with bases, is $C_9H_{10}SO_4$. The author describes the following salts of sulpho-hydrocinnamic acid:—Acid sulpho-hydrocinnamate of potassium, $C_9H_9.KSO_4$, obtained by carefully precipitating a solution of acid sulpho-hydrocinnamate of barium with neutral sulphate of potassa; the addition of alcohol to the aqueous fluid causes the precipitation of the compound potassa salt just named, which does not contain any water of crystallisation, and was, on analysis, found to contain 14·58 per cent of potassium. Neutral sulpho-hydrocinnamate of potassium, $2C_9H_9K_2SO_4+H_2O$, obtained by neutralising a solution of the preceding salt.—This neutral salt crystallises in clinorhombic, prismatic-shaped crystals, from its concentrated solution in dilute alcohol; the salt contains 2·86 per cent of water, and 24·77 per cent of potassium. Neutral sulpho-hydrocinnamate of ammonium, $C_9H_{10}SO_4.2NH_3+H_2O$, obtained by dissolving the sulpho-hydrocinnamic acid in an excess of ammonia.—The salt crystallises spontaneously, but is obtained in more beautifully crystalline state by the addition of absolute alcohol to a warm and concentrated aqueous solution of the salt, which, in its anhydrous state, contains 12·88 per cent of ammonia. Acid sulpho-hydrocinnamate of barium—

$$C_{18}H_{18}BaS_2O_{10}+3H_2O,$$

crystallises most readily from a solution which contains a slight excess of the sulpho-hydrocinnamic acid.—The percentical composition of this salt is—Carbon, 33·29; hydrogen, 3·70; barium, 21·11; sulphur, 9·86; water, 8·32; oxygen, 23·72. Neutral sulphydrocinnamate of baryta, $C_9H_8BaSO_4+H_2O$, obtained by adding to a solution of the acid baryta salt a slight excess of hydrate of baryta; that excess is first removed by a current of carbonic acid, and, after filtration, the liquid deposits, by spontaneous evaporation, or by being heated on a water-bath, a white-coloured crust, of a non-crystalline mass. The salt contains 4·70 per cent of water and 37·57 per cent of barium. Acid sulpho-hydrocinnamate of cadmium, $C_{18}H_{18}CdS_2O+4H_2O$, contains 17·45 per cent of cadmium. Neutral sulpho-hydrocinnamate of silver, $C_9H_8Ag_2SO_4$, a crystalline salt containing 48·43 per cent of silver. Acid sulpho-hydrocinnamate of copper, $C_{18}H_{18}CuS_2O_{10}+4H_2O$.—When a solution of the acid sulpho-hydrocinnamate of baryta is carefully precipitated with a solution of sulphate of copper, a green-coloured liquor is formed, which, on being concentrated, deposits a crystalline apple-green coloured salt, and a pale blue-coloured amorphous substance, which is the basic copper salt. The neutral salt contains 12·13 per cent of water, and in dry state, 12·06 per cent of copper. The formula of the basic copper salt is $C_{18}H_{18}Cu_2S_2O_{12}+3H_2O$.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, 1870.

This number contains the following original papers and memoirs:—

Contribution to the History of the Nitriles.—Dr. A. W. Hofmann.—After quoting a portion of a paper published by the author in the *Comptes Rendus* for September 9th, 1867, he proceeds to state—Isocyanamyl and cupronitrile appear to be the ends of a chain of isomeric bodies, between which there must exist a lengthy series of other bodies which have to be formed by the dehydratation of butylamine acetate, propylamine propionate, ethylamine butyrate, and methylamine valerate. The paper contains, next, a series of lengthy formulæ; and the author further proceeds to say that anhydrous phosphoric acid, which acts violently on ammoniacal salts, also causes considerable decomposition when allowed to act upon the salts of the primary monamines; it might, therefore, be preferable to act upon the corresponding monaminamides.

Beryllium Platino-Chloride.—J. Thomsen.—Beryllium platino-chloride is very readily soluble in water, crystallises very easily, is deliquescent, but not altered when exposed to dry air. When rapidly crystallised, it forms an orange-coloured crystalline powder; when slowly crystallised, it forms short prismatically-shaped crystals. The composition of this salt is $PtCl_4+BeCl_2+9H_2O$. Heated to 120°, the salt loses five molecules of water, while the rest of that fluid is not even driven off at 200°; the composition of the dry salt is, therefore, $PtCl_4+BeCl_2+4H_2O$.

Alleged Derivation of the Law of Avogadro from the Mechanical Theory of Heat.—J. Thomsen.

Relation of Chemistry to Mineralogy.—Dr. C. Rammelsberg.—This paper, a lecture, is reserved for full translation.

Alloy of Lead with Platinum.—A. Bauer.—After referring to the observation of M. Deville, that an alloy of lead and platinum is readily decomposed in consequence of the conversion of the lead into white-lead, the author made an alloy, consisting of 3 parts of pure lead and 1 part of platinum. This alloy is so brittle that it can be readily pulverised; and the powder so obtained was moistened with water, and placed under a bell-jar exposed to the action of carbonic acid, oxygen, and vapours of acetic acid. The conversion of the lead into white-lead took place rapidly; and, after it appeared that all the lead was converted into white-lead, the powder was treated with acetic acid, and the residue again exposed under the bell-jar to the action of the same substances. This process having been repeated several times, there remained at last a steel-greyish coloured crystalline powder, which only appeared to be finely-divided platinum. On being treated, however, with dilute nitric acid, the author found that the powder consisted of an alloy of lead and platinum, which contained, in 100 parts—Platinum, 48·82; lead, 51·18; corresponding to the formula Pt+Pb. This alloy has a sp. gr. of 15·77, is readily decomposed by mineral acids, but withstands boiling with acetic acid when rapidly fused it is, after cooling, a bismuth-like, crystalline, very brittle metallic mass. The alloy, submitted in a muffle to the process of oxidising ignition, fuses, the lead is driven off, and platinum left.

This number contains a tabulated form, exhibiting the rules and prescriptions to be observed for disinfection, as drawn up by a committee of the Chemical Society of Berlin, and bearing upon the necessities occasioned by the war.

Bayerisches Industrie und Gewerbe Blatt, August, 1870.

This number opens with a lengthy communication, issued by the Bavarian Minister for Trade Manufactures and Home Affairs, concerning the—

Manufacture, Keeping, Sale, and Transport of Gunpowder, Gun-Cotton, Fireworks, and Detonating or Explosive Materials.—This communication, based upon Article 169 of the Bavarian Penal and Police Code, proves, in a very high degree, the eminent technical knowledge possessed by the parties by whose care this excellent regulation has been drawn up, so as to ensure perfect safety, yet not to hamper proper freedom of action, by all concerned.

The following original papers and memoirs relating to chemistry and collateral sciences are contained in this number:—

Fermentation.—Dr. A. Weinberg.—This very exhaustive memoir, a lecture given before the Chemical Society of Münich, contains a condensed review of all that has been done by scientific men to elucidate the phenomena of fermentation. The author ranges the different investigators of this subject into the following groups:—(1) Those who consider fermentation to be a purely chemical process, the result of the chemical action of the ferment or yeast on the sugar; MM. Trommsdorff and Meissner are the founders of this theory. (2) Those who consider fermentation to be a process of galvanic decomposition called forth by the dualism of the exciting body in a conducting fluid; this theory was founded by M. Kämtz, and among its adherents are MM. Schweigger, Colin, and Kölle. (3) Those who consider it as a catalytic process, or as due to the action of porous bodies; this theory was founded by M. Berzelius. (4) Those who consider that fermentation is due to the action of certain nitrogenous matter, which is itself permanently in a state of decomposition, which is imparted to the sugar as soon as it (the sugar) comes into contact with the decomposing nitrogenous matter under favourable conditions—the consequence being the splitting up of the sugar into alcohol and carbonic acid; this view has been established by Dr. von Liebig, and is adhered to, among others, by MM. Frémy, Löwig, Gerhardt, &c. (5) Lastly, fermentation is viewed as being a kind of process of vegetation, the newly-formed yeast being considered as the newly-generated plant; this view is held by MM. Erxleben, Cagniard-Latour, Schwann, Dumas, Mulder, and others. The author relates the history of the views held on fermentation, as just alluded to, at some length, and winds up his lecture with a review on Dr. von Liebig's well-known essay recently published on this subject.

Drying of Wood.—R. Gottgetreu.—This paper is substantially the subject-matter of a lecture before the meeting of the Polytechnic Society of Münich in reply to the query, What means are applied at Münich for the proper drying of wood required for architectural, joiner's, and other purposes? The author enters, first, into a series of particulars relating to the very varying quantity of water (moisture and juices) contained in various kinds of wood at different periods of the year, from which it appears that, according to Dr. Hartig's experiments, woods (trees) generally contain, during the winter months, about an average of 50·7 per cent of moisture; in March and April, about 46·9 per cent; in May, June, and July, about 48 per cent; while up to the end of November the quantity of moisture increases but little. Air-dried wood (timber) contains from 20 to 35 per cent of water, and never less than 10 per cent. Wood which, by being artificially dried, has been deprived of all moisture, is thereby entirely altered as regards its cohesive strength—it becomes brittle, loses its elasticity and flexibility. In order to dry all kinds of timber by artificial means, so as to preserve the essential physical structure, and, thereby, the good properties of the wood, the drying should be effected slowly, and the temperature to which the timber is submitted should be moderate to begin with, and care should be taken not to eliminate all the water. The author enters into details, illustrated by engravings, on the best means of drying timber on the large scale, and states that small pieces of wood, such as are intended for joiners and furniture-makers, may be readily and efficiently dried by being placed in dry sand, and then heated to 100°. The sand acts in the manner of an absorber of the moisture, as well as a diffuser of the heat.

Some of the Reactions of Water-Glass.—Dr. F. A. Flückiger.—The author has instituted a series of experiments on the action of various salts soluble in water upon the so-called water-glass, solution of silicate of soda. As a general rule, the author found that the soluble salts of potassa, soda, lithia, and ammonia, more readily in water, possess the property of throwing down silica from a concentrated solution of silicate of soda. The experiments were made with a solution of silicate of soda of 1·392 sp. gr., which contained so slight an excess of soda that a single drop of alcohol, or a very weak acid, immediately precipitated silica from the solution. One part of this silicate solution diluted with 29 parts of water gives, with a solution of sal-ammoniac (1 of salt to 8 of water), upon being gently heated, a precipitate of silica. Caustic ammonia (sp. gr., 0·921) separates from the silicate solution, when cold, silica, but the precipitate is re-dissolved on heating. Propylamine also decomposes the silicate solution. The bromide and chloride of potassium in cold saturated solutions decompose the silicate solution on heat being applied, but not so in the cold. A drop of bromine, a single bubble of chlorine gas, a drop of creosote (Reichenbach's), a drop of carbolic acid dissolved in glycerine, also dilute solutions of

albumen and gelatine, or glue, decompose the silicate solution, which is similarly affected by a solution of gum Arabic; while, on the other hand, other kinds of gum and mucilage, sugar, dextrine, glycerine, and urea do not decompose the silicate solution.

NOTES AND QUERIES.

Dextrine—Lactic Acid.—Is there any quick and ready process for determinining the presence and quantity of dextrine in a vegetable solution? Can it be distinguished from glucose when present in the same liquid? What is the best mode of determining the presence of lactic acid?—CARBON.

Action of Light on Germination.—I remember reading in your journal, some years ago, a statement, made by some foreign chemist, I think, that placing blue glass in the windows of a malt-house will materially hasten the process of malt-making. I have since looked through the first eight volumes repeatedly, but have failed to hit upon the paragraph.—ALFRED ASHBY.

[We have looked through the CHEMICAL NEWS, also the general index to the *Jahresberichte über die Fortschritte der Chemie*, and, lastly, the Table Générale des *Comptes Rendus des Séances de l'Académie des Sciences* from 1835 to 1865. The only paper which relates to the subject is "De l'Influence Qu'exercent sur la Végétation des Plantes, et la Germination des Graines, les Rayons Solaires Transmis à Travers des Verres Colorés. M. Zantedeschi (*Comptes Rendus des Séances de l'Académie des Sciences*, vol. xvi., p. 71).—*Ed. C. N.*]

Condensation of Nitrous Vapours.—I observe, in the CHEMICAL NEWS of Nov. 4, R. Heilmann and P. Hart have introduced the use of lime for condensing the nitrous vapours evolved in the manufacture of H_2SO_4. I beg to intimate that Mr. Barron, of Manchester, has used dry lime to condense nitrous vapours for the last ten years; and I believe I was the first to mix the solution of calcic nitrate with potassic chloride, to obtain potassic nitrate—

$$Ca_2(NO_3)+2(KCl)=2KNO_3+CaCl_2.$$

Practically, solution of $Ca_2(NO_3)$ cannot be distilled with H_2SO_4 in the ordinary nitric acid cylinders, owing to the acid acting upon the iron very rapidly. It must be in the solid state. Where magnesic sulphate forms part of the manufacture, I use lime made from dolomite limestone, which gives magnesic and calcic nitrates; and when distilled with H_2SO_4, we get soluble $MgSO_4$ and insoluble $CaSO_4$. The mixture is digested with H_2O, a little CaH_2O_2 added, to throw down ferric oxide, allowed to settle, syphoned off, and boiled to crystallising point, &c. By the use of lime on the large scale I have condensed the vapours from the manufacture of nitrate of iron, used by dyers, &c., which, in reality, is a ferric sulphate, the whole amount of hydric nitrate being decomposed into nitrous vapours. Also the nitrous vapours evolved in the conversion of arsenic trioxide into arsenic pentoxide. I was told by a large aniline colour maker that he sent up his chimney £100 worth, per month, of nitric acid; and his works are known by the name of "Red Smoke Works." Also the vapour evolved in making nitrobenzol from benzol. Iron turnings can be substituted for lime in the case of nitrate of iron.—H. H.

MEETINGS FOR THE WEEK.

MONDAY, 28th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)
—— Medical, 8.
—— Royal Geographical, 8.30.
TUESDAY, 29th.—Institute of Civil Engineers, 8.
WEDNESDAY, 30th.—Society of Arts, 8.
—— Royal, 4. Anniversary.
THURSDAY, Dec. 1st.—London Institution, 7.30. Prof. Morris, F.G.S., "On Gems and Precious Stones."
—— Chemical, 8. W. H. Perkin, F.R.S., "On some Anthracen Derivatives."
FRIDAY, 2nd.—Geologists' Association, 8.

TO CORRESPONDENTS.

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ERRATA.—Page 242, column 2, line 20 from bottom, insert *nuclei*. Page 243, column 1, line 5 from top, instead of *analogous* read *anhydrous*.

Professor C. A. Seely (New York).—Thanks; our publisher will attend to your request.

Dr. C. M. Wetherill (Bethlehem, Pennsylvania).—Your communication just to hand; it shall receive early attention.

W. C. Roberts.—We are much obliged for the report.

R. R. Tatlock.—Received with thanks.

Rev. H. Highton.—Your letter shall be inserted in our next.

Clews, Habicht, and Co.—Received.

E. Ronalds.—Forwarded.

A VICTIM OF THE WAR.

To the Editor of the Chemical News.

SIR,—I am quite sure I do not need to do more than ask the cosmopolitan Editor of the CHEMICAL NEWS to lay before the community of English manufacturing chemists the following extract from a letter received by a friend of mine in this city from Judge Neel, of Jersey, Channel Islands, and to whom, I may add, any communications on the subject of it might be addressed:—

"But the immediate object of my writing to you is to solicit your aid in finding a situation for a German gentleman whom this cruel Franco-Prussian war has thrown upon our shores. He was analytical chemist to the Western Railway of France, having Paris as his headquarters, with a salary of £400 a year. He was compelled to fly for his life, and was placed, by his employers, at Le Mons; after awhile, he was assailed there also, and has been obliged to leave France altogether. His former employers write him that the national feeling against the Germans is so great that it will not be prudent for him to return to France after the war, and that, therefore, he had better find a situation somewhere else. He wishes to remain in England. He has been placed, as it were, under my protection by a friend, and I feel great interest in him. He is a Lutheran protestant, single, but has a sister living with him, is twenty-nine years of age, and speaks English sufficiently well to make his way in England. He is a first-class theoretical and practical chemist and manipulator; an inventor; a translator of chemical works from German into French. He has given special attention to the utilisation of gas products; the manufacture of colours and dyes from coal-tar, of ammoniacal salts from the ammoniacal liquor, &c.; also to the manufacture of paraffin oils from petroleum and coal-shale, paraffin candles, &c. Would you kindly make enquiries, and let me know the result as soon as possible, as my friend's means are all but exhausted."

Should any one of your numberless chemical manufacturing readers have a vacancy which would enable him to obtain such an accession to his staff, he might, I think, serve both himself and his country in bringing a man of talent and technical skill to her shores.—I am, &c.,

FRANK SPENCE.

Manchester, Nov. 14th, 1870.

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THE CHEMICAL NEWS.

VOL. XXII. No. 575.

ON THE

ACTION OF NUCLEI ON SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By CHARLES TOMLINSON, F.R.S.

I HAVE read with very great interest the paper by Mr. A. Liversidge "On Supersaturated Solutions of Sodic Sulphate," contained in the last two numbers of the CHEMICAL NEWS.

Being very much occupied just now with literary work, I am unable to reply to that paper in a manner worthy of its author or the subject, which he handles with fairness and skill—but I hope to be able to do so shortly. At present, I propose to make a few remarks on the first half of Mr. Liversidge's paper; the second half will require more time on my part than I can at present afford.

Mr. Liversidge does not see the bearing of the camphor experiment on the matter in hand, namely, the crystallisation of a supersaturated solution of sodic sulphate. He imagines that the film arising from a secretion from the finger "may act by arresting the evaporation both from the surface of the water and from the camphor, for the latter in its movements would pick up a coating of oily matter, through which evaporation would not readily take place."

This, I imagine, is not the modern view of the phenomena of the camphor movements as taught by Van der Mensbrugghe and confirmed by Plateau and others. The motions of the camphor fragments depend on the surface tension of the water; and the effect of the secretion from the finger is to degrade this tension from that of pure and chemically clean water to that of camphor julep, when, of course, motion of the fragments is no longer possible.

When a quantity of a newly distilled essential oil, amounting to about 10 or 20 drops, is placed on the surface of chemically clean water in a clean shallow glass vessel about 3½ inches in diameter, it assumes a lenticular form, and is separated from the water by surface tension. If now some fragments of camphor be scraped upon the surface of the lens or of the water, or both, they at once become very active, skating through the lens and cutting it up in all directions. A solution of the camphor in the oil surrounds each fragment, and an iridescent film spreading from it as it sails about gives it an elegant appearance, often so symmetrical as to make it appear like a small brilliant butterfly. But what I want to insist on is the different conditions of the oil lens and the camphorated oil film; the one is separated from the water by surface tension, the other is closely adhering to it, overcoming or greatly lowering surface tension.

Now, when a drop of a liquid is placed on the surface of another liquid, there happens (apart from chemical action), one of three things:—(1). It diffuses through the liquid, and in general does not act as a nucleus to a supersaturated solution of sodic sulphate. (2). It spreads out into a film. (3). It assumes a lenticular shape. It becomes a film or a lens according to the general proposition, that if on the surface of the liquid A, whose surface tension is a, we deposit a drop of the liquid B, whose surface tension b is less than a, the drop spreads into a film; but if b be greater than a, or only a little less, the drop will be lenticular. Hence, if B spread on A, A will not spread on B.

In my experiments on the nuclear action of films it was quite easy to distinguish between the action of the film as such and that of a speck of dust from the air or contained in the film. When the film spreads so as to overcome the surface tension of the water, or rather when the surface tension of the water is lowered at the contact surface common to the oil drop and the water, the surface of the latter not so acted on exerts a tensile strain upon the drop outwards in all directions, and so spreads the drop into a film, at the same time drawing it into close adhesion with the surface. It is this close adhesion which constitutes the first step in the nuclear action of films, the second being that differential kind of action by which I define a nucleus. Now, supposing the film to be thus produced, large flat crystals with dihedral summits of the 10-atom sodic sulphate are moulded, as it were, upon the lower surface of the film, parallel with it and limited by it, and as one set of crystals is formed and falls off, another set is produced, and yet another, until supersaturation ceases.

But when crystallisation sets in from a nuclear point or points, such as a speck or specks of dust, each point propagates its action downwards in minute crystalline lines at right angles to the surface or at angles of various magnitudes, and the crystals proceed to the bottom in close well packed lines, a phenomenon which is quite familiar; but I may be excused for the remark that the action of the film in forming large well-shaped crystals was, I believe, first described by me.

But now comes the question as to Mr. Liversidge's ingenious experiments, in which he succeeded about 120 times, or as many times as there were experiments, in placing thin films on his solutions without any separation of salt in any one case.

It will doubtless be granted that, in order for a film to act, it must be in contact with some part or other of the solution. If it be separated therefrom by surface tension it will not act. Mr. Liversidge, in order to get a film on the surface of his solution, makes an ethereal solution of the film-forming substance, and deposits a drop of that, trusting to the evaporation of the ether to spread out the film. Now any lowering of temperature increases surface tension, and my present impression is, that the evaporation of the ether so far increased the surface tension of the solution, that the film never once adhered to it, but was always separated from it by the superficial tension of the solution.

So, also, when Mr. Liversidge kept his clean finger in a solution lowered in temperature to 33° F., the surface tension of the solution was lowered thereby and the solution was separated from the finger by that tension. Had he been able to draw his finger strongly against the side of the flask, it is most likely crystallisation would have set in just as in my camphor experiment the fragments were brought to rest by a similar artifice. I have, on several occasions, kept my finger in highly supersaturated solutions of sodic acetate cooled down so as to be viscous, and protected from nuclei by a thin layer of oil, without any nuclear action, but on drawing the finger sharply against the side of the vessel so as to produce a *smear*, the whole became solid and very hot.

So, also, in the case of the glass rod and the greasy flask experiments—the solution rolled over them without wetting them. In other words, the solution or globules of the solution did not lose their surface tension to a sufficient extent to be brought into contact with the greasy surfaces.

Highgate, N.
November 28th, 1870.

PS. Since writing the above I have found time to perform two experiments.

Expt. 1.—A very strong solution of sodic sulphate was boiled in a large flask and then filtered into six small flasks, each of which was again boiled and set aside to cool, covered with a watch-glass.

Some oil of citronella, diluted with two or three times its volume of ether, was taken up in a straight dropping-tube furnished with an india-rubber shield, as described in my

mode of testing M. Jeannel's experiment (see CHEMICAL NEWS, vol. xxi., p. 52).

The watch-glass was gently removed from the flask No. 1, and the dropping-tube inserted; after some minutes a drop fell from the tube, the ether in spreading over the surface described its cohesion figure, and the solution crystallised immediately. In Nos. 2 to 5 the dropping-tube was lowered so as to deliver the drop very gently, or it was allowed to trickle down the side of the flask. In two cases the ether evaporated and left the oil on the surface in minute lenses; there was no crystallisation even on gently shaking the solution. In No. 4 a film was formed on the side of the flask; on inclining it so as to bring the solution into contact with it, crystallisation set in. In No. 6 a film was formed on the surface; but on gently shaking the flask the solution became solid.

Expt. 2—A very strong solution of sodic sulphate was filtered into eight flasks, which were re-boiled and covered as before and left undisturbed until the next day. The ethereal solution was made more dilute in order to avoid, if possible, the formation of lenses. The solutions Nos. 1, 2, 3, and 4 crystallised the moment the ether solution spread over the surface.

The ethereal solution was now made less dilute; that is, about 10 drops of the oil were diluted with about 20 drops of the weak solution. A drop or two of this was allowed to run down the side of No. 5, when the oil became lenticular. In No. 6 the oil in running down the side formed a film. On inclining the solution so as to make it meet the film, crystallisation at once set in. In No. 7 the dropping-tube remained some minutes in the flask, and the ether, instead of falling in a drop, evaporated, and the vapour condensed on the surface of the solution in the form of a well-defined circular film, from the lower surface of which a beautiful set of large crystals was produced. In the flask No. 8, the tube remained some minutes, and then a drop fell and spread, and the solution became solid.

I cannot help thinking that Mr. Liversidge's solutions are only just supersaturated. I have already hinted at this with reference to his former sets of experiments (see CHEMICAL NEWS, vol. xxii., p. 110). As far as my experience goes, results are not to be depended on unless the solutions are highly supersaturated, *i.e.*, saturated, or nearly so, at the point of maximum solubility, so that a little anhydrous salt is thrown down at the boiling-point. I should also like to know the proportions of oil to ether used by Mr. Liversidge in making his films.

NOTE ON ITACOLUMITE (ARTICULITE).

By CHARLES M. WETHERILL, Ph.D., M.D.

I FEEL grateful to Professor A. M. Edwards, for having directed attention to itacolumite (CHEMICAL NEWS, vol. xxii., p. 111), although I cannot accept the correctness of his conclusions. I am not unfamiliar with the use of the microscope, which has held the place of honour in my laboratory for twenty years; nor were my inferences hasty, since I made careful examination of some forty specimens, being sections of different kinds of the mineral, cut in the plane of deposition, and at various angles thereto. I have been surprised that the wonderful structure of itacolumite, which seems to warrant the name I have proposed for it, has not attracted greater attention. This I can only account for by the natural incredulity which the announcement of such a structure would inspire, and in which I shared at first, believing that my eyes deceived me. It was only after long and patient examination that I became convinced of the nature of the joints, which are indeed very easily seen, and which I have shown to many visitors to our University. It would give me great pleasure to show them to Professor Edwards, whose difficulty appears to be in the interpretation of my words "ball-and-socket joints," in the idea that the motion "is much marked in a direction at right angles at the lamination," and in the belief that the proof of the nature of the joints rests solely upon the microscope.

It may be said in respect to these—

(1). Each ball and socket does not admit of a great play, and is not smooth and perfect like that of the joint of a limb; it is, notwithstanding, perfect in principle of motion. The stone is built up of grains and congeries of grains loosely coherent, and forming irregular cavities in which are engaged projecting parts of other congeries or grains of sand, which are susceptible of a slight motion in the cavity—in some cases in one direction, and in others in several or in all directions. This freedom of motion is of the true quality of a ball-and-socket joint.

(2). The motion is *not* most "marked in a direction at right angles to the lamination." It is certainly so if a piece be taken of which the thickness is small in proportion to the other dimensions; but that is not the method by which the true motion is shown. A properly made section is susceptible of as much motion in the plane of lamination as at right angles to such a plane.

To prove this, I refer to the experiments (*American Journal of Science*, vol. xliv., July, 1867), upon a cylindrical rod of the mineral, 198 m.m. long and 13 m.m. in diameter, which was sawed from a thick block, and of which the axis was parallel to the planes of stratification. Supporting this rod upon two nails 185 m.m. apart, in order to determine the nature of the curve it assumed, the deflection was found to be essentially the same when the cylinder was rotated upon its axis on the supports. The difference was ½ m.m. of its greatest deflection of 3½ m.m., and had no relation to the stratification, being caused by a slight crack.

(3). The proof of the nature of the joints does not rest solely upon the microscope, although that alone is sufficient. The motions of the cylindrical rod afford an independent and equally convincing demonstration of the ball-and-socket character. There is no other kind of joint which could explain the motions which this rod is susceptible of, viz.:—"It can be *compressed* and *elongated* in the direction of its axis, the extent of motion being a little over ½ m.m. When one end is fixed, the other end may describe a circle of 34 m.m. diameter, and may be made to *touch every point in the area of the approximate spherical zone*. The rod can also *be twisted about its axis*, the torsion being 10°." I may add that, by shaking the rod near the ear, one may hear the clicking of the joints as the motion is arrested at the limit of their greatest play.

The nature of the curve (nearly a catenary) when the rod is supported by its ends, agrees with the joints which I have described, and confirms also the revelations of the microscope.

I have never seen anything so wonderful as this rod of itacolumite. When held by one end upward, it totters in all directions, so that no one, seeing it at a short distance, believes that it is a stone. A gentleman from California, to whom it was shown, suggested jocularly that it would do well to build houses with in his earthquake shaken state. Indeed, I have no doubt that a sufficiently high and thin well-built wall would be susceptible of a decided motion before cracking. The height of wall, so much greater than its thickness, would permit the play of the innumerable small joints, existing from the bottom to the top, to be perceived.

In order to see the joints, a thin section, supported at one end or at both ends, may be moved while under the microscope with a needle point; by changing the position of the section, a part may be reached at which the play of the joints may be perceived. They can also be seen by *dissecting* a flexible piece of the mineral, using either a fragment or a surface rubbed flat. The surface to be examined is inverted, tapped, and, as far as practicable, brushed free from loose grains. It is then examined under the microscope with a power of 40 to 60 diameters.

The attention of the observer is first attracted by the irregular pits or depressions formed by grains of sand.

By very delicate touches with a fine curved needle point, the surface may be investigated; loose grains of sand are seen and removed. Touching other grains and congeries of them delicately with the needle, proves that some have motion in a cavity formed of grains of sand cemented together. These are dissected out, and other movable groups are found. Some have less motion than others, and some are immovable. By patient investigation of the mineral in this way, the observer will rise satisfied that it is made up of joints of the character which I have described.

This mineral is worthy of greater attention than has been bestowed upon it, Why are some of its constituent grains cemented together in such a curious fashion, and not all of them? I hazarded an explanation which was the best I had, but which was unsatisfactory to me; doubtless, some other observer will be more fortunate. It would not be surprising if the elucidation of this point would throw some light upon the origin of the diamond. Has itacolumite been found near the new diamond region of South Africa?

Bethlehem, Pennsylvania.

ON THE

COMPOSITION OF CRUDE SODA

(SO-CALLED SODA ASH OR BLACK ASH); AND ON THE

LOSS OF SODIUM BY THE MANUFACTURE OF SODA ACCORDING TO LEBLANC'S PROCESS.

By M. A. SCHEURER-KESTNER.

As a result of investigations and researches made by me some few years ago on this subject, I found that crude soda contains, essentially, carbonate of sodium and sulphide and oxide of calcium in the proportion of from 1¼ to 1½ molecules of calcium to 1 of sodium. The crude soda contains, moreover, all the foreign substances due to the impurities of the primary matters employed, as, for instance, silica, alumina, peroxide of iron, excess of carbonaceous matter, &c. Solutions of crude soda in water, treated with carbonic acid gas, after previous filtration to eliminate the matters insoluble in water, yields a white precipitate of silicate of alumina; this precipitate was found to be percentically composed of—Silica, 32·7; alumina, 44·0; water, 23·3;—formula, $Si_3Al_2O_{12}+6H_2O$. By re-crystallising several times the soda contained in the solution just alluded to, the mother-liquors of these operations will contain the bulk of the impurities. Beside oxygenated sulphur compounds, I have found, in these liquors, seleniate and sulphocyanide of sodium. The selenium is derived from the sulphuric acid which has served for the preparation of the sulphate of soda, the acid alluded to having been made from the Chessy (France) pyrites, which contain a small proportion of selenium. The sulphocyanide of sodium is due either to the action of the air upon the soda while in pasty fused state, or is derived from the nitrogen of the coals which are used in the reduction process. The presence of this sulphocyanide is the cause of the ammoniacal smell given off by the ball soda while exposed to moist air for the purpose of cooling. In order to prove the presence of the compound just alluded to in ball soda, it is only necessary to exhaust it with alcohol; the ensuing solution is somewhat coloured, the colouration (either red or yellow) being due to traces of croconate and rhodizonate of sodium. I found, by treating 100 grms. of crude soda with alcohol, and evaporation of the liquid, 73 milligrms. of sulphocyanide of sodium. The seleniate of soda is found by precipitating the mother-liquors with a soluble salt of lead until the ensuing precipitate ceases to be coloured; by decomposing this precipitate by means of sulphuretted hydrogen, a mass is obtained which, when ignited, gives off the characteristic vapours of selenium. All the substances just alluded to occur in the normal crude soda; but, if that substance has been over-heated (too strongly ignited), it also contains sulphide of sodium, NaS, derived from the reaction of the carbonate upon the sulphide of calcium. $2CaS+Na_2CO_3=2NaS+CaO+CO$.

Loss of Sodium during the Preparation of the Soda.—It is a well-known fact that, when working on the large scale, Leblanc's process does not yield, in practice, anything like what, according to calculation and theory, should be obtained. There is a loss of soda attributed by many chemists (including Dr. Unger, who found the loss from volatilisation of sodium alone to amount to one-fifth in one operation; while Dr. Stromeyer also ascertained the volatilisation of this metal, while experimenting on the large scale to carry out M. E. Kopp's process of soda making, by treating sulphate of soda with coal and oxide of iron) to volatilisation of metallic sodium occurring during the fusion of crude soda in the calcining furnace, because the soda retained as a soluble salt in the residue (waste) is not sufficient to account for the total loss.

The residues, or soda-wastes, are always found to retain a certain quantity of soda as soluble salts; but they contain a far greater quantity of soda in a state insoluble in water. The loss of soda incurred during the process of manufacture is therefore due to several causes, and among these—(1) to volatilisation of sodium in the calcining furnace; (2) soluble salts of soda retained in the waste in consequence of imperfect lixiviation; (3) soda retained as insoluble compounds in the waste; and (4) loss due to the manipulations of the liquors and salts during the process of manufacture. In order to determine the quantity of sodium volatilised during the calcination, it is required to operate upon materials of well-known composition, and estimate the sodium very correctly in all the products obtained. I am indebted to the kindness of M. Usiglio, who has made a series of such experiments, for his communications on this subject, especially the full account of his method of experimenting, which is so correct and good as not to leave anything to be desired.

Average samples of the sulphate of soda, chalk, and coal intended to be furnaced have been taken, and the quantities to be furnaced, as well as the ball soda, have been weighed as exactly as possible, and samples of all have been analysed with great accuracy, so that by these means, we could come to the knowledge of the quantity of sodium volatilised. My experiments, as well as those of M. Usiglio, have proved that, during the conversion of sulphate of sodium into crude soda (ball soda), no volatilisation takes place at all. The whole of the sodium originally present in the sulphate of soda is found in the crude product; but, if the furnace-temperature is too high, a small quantity of chloride of sodium is volatilised. Upon 1216 kilos. of sodium, as present in 3965 kilos. of sulphate of soda, I have found, in 6558 kilos. of crude soda, 1216 kilos. of sodium again. M. Usiglio has estimated quantitatively, in the raw materials, as well as in the crude product, the relations existing between the calcium, sulphur, and the sodium, and found—

	In the raw materials.	In the crude soda.
Sodium	31·68	31·49
Calcium	45·66	45·62
Sulphur	22·66	22·89
	100·00	100·00

If, therefore, any volatilisation takes place at all, it is clear that one should have to admit that the three elements sodium, calcium, and sulphur become volatilised exactly in the same proportion. Since it is thus proved that, under ordinary conditions, no reduction nor volatilisation of soda-salts and sodium takes place during the furnacing process, we have to look, therefore, in another direction for the causes of the loss of sodium daily experienced during its manufacture. The chief seat of this loss is proved to be the so-called soda-waste, which generally, it is true, retains, after lixiviation, only about 1-100th of soluble soda-salts; but the quantity of salts of

that base contained therein in the state of combination insoluble in water varies considerably. For instance, M. Unger found that the total quantity of soluble and insoluble sodium amounted, in the wastes of the Rinckuhl Alkali Works, to 1·06 per cent; M. Kopp* found the waste of the works near Dieuze to contain 4·36 per cent; Mr. Brown† found the waste of the works at Cassel to contain 1·01 per cent; and Dr. Muspratt‡ states that the average at the Newcastle-on-Tyne alkali works amounts to from 1 to 2 per cent of sodium retained in the waste. I have had ground up 4000 kilos. (4 tons) of soda waste, and, after having thoroughly mixed this mass, have taken a fair average sample, which, after drying, has been analysed and found to contain—Insoluble sodium, 1·67; soluble, 0·17;—total, 1·84 per cent sodium. Another experiment, made with an average sample again taken from the quantity just alluded to, but not the same waste, has yielded—Insoluble sodium, 0·99; soluble, 0·43;—total, 1·42 per cent sodium. Since crude soda (black ash) leaves about 60 per cent of waste, and contains about 18·65 per cent of sodium, there results a loss of about 5 per cent of sodium in the state of insoluble compounds of that metal as retained in the waste.

The true nature and precise composition of this compound are unknown; the bluish hue of the waste favours the correctness of the opinion expressed by some makers that some ultramarine is formed. M. Kopp calculates this substance as sulphuret of sodium; and Mr. Brown notes it down in one of his analyses as sulphuret, and in another, again, as carbonate. The differences observed between the laboratory experiments made on crude soda and the results obtained by the lixiviation on the large scale, appear to indicate that a portion of the soda is rendered insoluble in water by its prolonged contact with water and the sulphides of the waste. However this may be, my researches prove—(1) that during the calcination process (furnacing) no soda-salts are reduced to metallic sodium; and (2) that the greater part of the loss of sodium is due to the formation of insoluble sodium compounds which are retained in the waste, a loss which certainly is never less than 5 per cent, and often very much larger.

ON THE FUSIBILITY OF PLATINUM IN THE BLOWPIPE FLAME.

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

The metal platinum has hitherto been supposed to be infusible, except at a temperature that is so high, as to be incapable of being produced by the common blowpipe; at least I have carefully searched for any statements to the contrary without success.

When I was lately engaged in studying the effects of the hot-blast blowpipe flame, the results of which investigation have already been communicated to the Wellington Philosophical Society, I found it necessary to test, with accuracy, the degree of fusibility of platina; and discovered that if the loss of heat from the flame, by conduction, was guarded against, platinum can be fused with an ordinary blowpipe blast through a candle flame. The method adopted was to substitute, for the metallic nozzle generally employed, a tube of clay or glass, either of which is a feeble conductor of heat, as compared with metals.

By this means fine platinum points were fused in an unmistakable manner to beads. The blast was that ordinarily used in the laboratory by the use of the hydrostatic blowpipe, the flame being that of a stearine candle.

As it might be urged that, perhaps, the platina I treated might contain an admixture of more fusible metal, and that its melting-point might thus be reduced, I prepared some of the platina for special trial, which was absolutely free from such fusible metals.

As the fusing-point of platinum has been ascertained to be 4303° F., we must, from the above experiment, conclude, that if proper precautions are taken to prevent loss of heat by conduction, this high temperature can be produced by the ordinary blowpipe operating upon flames of this description.

* *Comptes Rendus*, vol. lxi., p. 797.
† *Philosophical Magazine*, vol. xxxiv., p. 15.
‡ *Chimie Appliquée à l'Industrie.*

ON FERMENTATION.*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from p. 248).

Then there are some other processes of considerable importance, from their occurrence in the animal economy—processes which, I believe, must be classed between those experiments which I showed you a little while ago and the process of fermentation—I mean processes which occur in the operation of digestion. I have here a gelatinous solid, which contains a substance called pepsin, which was made by dissolving the inner lining of a pig's stomach in diluted hydrochloric acid at about blood heat. The inner lining of the stomach of that and similar animals is dissolved gradually, and that solution possesses the property of dissolving muscular fibre, white of egg, and other similar substances; it is, in fact, artificial gastric juice, and it would, for instance, dissolve that lump of gluten which I showed you just now—which looked something like india-rubber—and when this pepsin dissolves albumen by digestion, for the process is doubtless of the same kind as that which occurs in the animal economy, it does so by breaking it up into bodies which are, no doubt, simpler than itself, bodies which we do not know accurately and fully. They are called peptones, for it is common enough to give names to bodies, even before one knows them well. I do not know whether it is a good plan, but it is customary. These bodies are a good deal similar to those which are present in malt, and in such like mixtures which have undergone vital changes.

Then I will give you one or two other cases of similar processes. Here is a singularly beautiful acid, called hippuric acid, which decomposes with very great readiness if left in the liquids in which it is originally found. When that organic mixture is exposed to the air it undergoes a process of putrefaction. The general appearances which take place in the liquid while the substance is decomposing would certainly be described by anybody as a putrefactive process, and there is formed by its decomposition some of this other beautiful acid, called benzoic acid, because it was originally obtained from the fragrant gum benzoin. At the same time there are other products given off which decompose. Now, we can by mineral substances, effect the same decomposition of that hippuric acid. A German chemist, to whom we owe many researches in these matters, showed, some years ago that, if you boiled hippuric acid with dilute sulphuric acid, it takes up water, and breaks up into benzoic acid, and this crystalline substance, called glycocol, or sugar of glue. It got that name from the circumstance that it was obtained originally from glue by a decomposing action, and it has a sweet taste. It has no analogy to sugar, in its nature, but it has that superficial resemblance that it is rather sweet.

This hippuric acid affords another case of a body which is broken up either by putrefaction, or by the action of dilute sulphuric acid. It affords a strong argument, and other cases I have adduced afford, like it, an argument that the action of these organic substances resembles the action of dilute sulphuric acid. If we get the same change in several cases by the action of an organic body as by the action of a mineral body, the fact certainly goes some way towards showing that the two substances must be, in their mode of action, generally alike. There is another case, that of urea, which in contact with water

* The Cantor Lectures. Delivered before the Society of Arts.

forms a carbonate. That may be done by either class of reagent.

There are, however, some chemical processes even simpler than these, and for that reason they are better known to us, which really may be studied with advantage side by side with those I have mentioned, and they will, I think, afford us, on further consideration, a key to the explanation of these processes. I will only mention two. One is a process which is well-known in its general features, and it is a process of breaking up truly analogous to those I have mentioned, but a perfectly simple breaking up of alcohol into two substances, both of them well-known now, one being water, and the other ether. It is a process which consists in dividing the elements of alcohol in such a way as to get nothing formed but these two products, though side by side with this change there are some secondary changes which do not belong to the process. This change is effected solely by the action of oil of vitriol or sulphuric acid. It has been long known, and it was a subject of wonder for some time that, if sulphuric acid is mixed with alcohol and heated, you can distil off some alcohol from the mixture in the form of these two products; then you may add some more alcohol, and if you distil that off, it is also broken up into ether and water; then you may add some more again, and you may go on adding alcohol to that original quantity of sulphuric acid, and it will decompose each successive portion into these two products. There is no limit known to the extent to which sulphuric acid will effect that change. You perceive, therefore, that this, in its general features, is a process analogous to those which we were considering at first.

I may illustrate that by an experiment. First, I will show you how we discover the presence of sulphuric acid. The common test is to add some salt of baryta—this which I have here is a chloride—to the sulphate, when we get at once a precipitate sulphate of baryta. The sulphuric acid, in making the ether, passes over into a compound that does not possess this property. I have some of it here. It is a clear liquid, and on mixing it with the same reagent I used just now you see that it will not form the precipitate, I put some of the same baric chloride into it, but, as you see, the liquid remains clear. But I can bring back my sulphuric acid to its original state. Mr. Taylor, my assistant, was heating some of it just now, and it has been standing so long that it has returned to its original state already. It has returned from the state in which it does not precipitate baryta to the state in which it does. There is in the process a successive departure of the sulphuric acid from its ordinary state, and a return to that original state; it is a kind of circle or cycle. The substance passes over into a compound which does not precipitate baryta, and then it returns again to its original form, and that is the key to the anomaly. When the sulphuric acid has effected the decomposition of one portion of alcohol into ether and water, it comes back again to sulphuric acid, becomes exactly what it was in the beginning, and is able to recommence precisely the same combination. I will give you another example of it. I have here a substance used in one of the commonest manufactures, that of oil of vitriol, in which the same operation occurs. I have there a substance at work called nitric oxide. It is converting a quantity of sulphurous into sulphuric acid. In principle it would so convert an infinite quantity, but in practice it is limited by convenience. It acts by carrying oxygen from the air to one portion of sulphurous acid and then to another, and thus it goes on, and effects successive oxidations of a great number of particles of sulphurous acid, forming sulphuric acid from them, and it does that in virtue of a process perfectly analogous to that which I just now mentioned. The gas, after one operation, returns to the same state in which it was in the beginning of the first operation; it is a cyclical process. I have here some of the nitric oxide combined with oxygen, and when in that state it has the red colour which you see in the flask. If we blow a little sulphurous acid into it, the red colour will disappear as the nitrous acid gives up the oxygen, the nitric oxide itself being a colourless compound, but in combination with oxygen it is red. As the sulphurous acid passes into it, the nitric oxide parts with the oxygen and becomes colourless, but on again blowing in a little oxygen it returns to its former red colour. This shows you that there are processes, of simple, normal, chemical action, somewhat analogous to those fermentive properties which I formerly described. Each one of these processes takes place in perfectly definite proportions, the peculiarity being that one material which takes part in them returns at the end of one operation to the same state in which it was at the beginning of the operation, so that the processes are cyclical, and this reagent is able, by acting successively on a large quantity of particles, to repeat its action very frequently upon them, and beyond what would appear to be its definite combining proportion. You see this red compound of nitric oxide and oxygen has lost a great deal of its red colour. I will not wait until it is completely bleached, but will blow in a little oxygen, when we shall get a return to the original deep red colour. This is the ordinary process by which sulphuric acid is made on a large scale in lead chambers. The sulphurous acid is allowed to remain a considerable time in the chamber, and is passed on from one to another, as it is acted on by the nitric oxide, which passes through the successive stages of its action by a process which I should be glad to name cyclical, as I shall have occasion again to revert to a similar process of the same name. At our next meeting I shall have to analyse some of the best known, and also some less familiar instances, of cyclical action, that we may arrive at a conception of their nature.

(To be continued).

ON THE INTRODUCTION OF THE

PRINCIPLE OF REPETITION INTO CHEMICAL ANALYSIS.

By BRYANT GODWIN.

THE method of repetition, so frequently and so advantageously employed in physical investigations, has not, so far as I am aware, been applied to chemical analysis. It seems, at least, desirable that it should be so applied, and I will here give a particular instance in which it may be employed with advantage. In the determination of iron by means of potassic hypermanganate, all the iron is, at the end of the operation, in the form of sesquioxide, while there is also a very small excess of unreduced hypermanganate. When the solution is boiled for a short time with pure zinc-dust, and then filtered through a ribbed filter, which is quickly washed with water previously boiled to expel air, the iron is wholly in the form of ferrous oxide, and the process of titration may be repeated a second time. After a new reduction, the iron may again be determined, and this process may be repeated until the volume of liquid becomes too large to be easily handled. The following analyses were made to test this process:—

0·4725 gr. ammonio-ferrous sulphate required, in five successive titrations, 49·0, 47·2, 48·7, 48·0, and 48·5 c.c. of potassic hypermanganate, 1 c.c. corresponding to 0·0014 gr. iron. The mean of these five determinations gives 14·31 per cent iron in the salt.

0·4888 gr. required, in seven successive titrations, 49·5 48·75, 50·5, 49·8, 49·7, 49·8, and 49·5 c.c. of hypermanganate, the mean of which gives 14·23 per cent iron.

The formula requires 14·27 per cent.

These analyses, which, with more practice and experience on my part, would doubtless have corresponded much more closely, will at least serve to show that the principle of repeated observations of the same quantity to be measured may sometimes be introduced into chemical analysis.—*American Journal of Science.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 15th, 1870.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

JOHN DURHAM BIRD, M.D.; Mr. John A. Bennion; Henry Deacon, F.C.S.; Mr Joseph Carter Bell, and Thomas Steadman Aldis, M.A. were elected ordinary members of the Society.

MR. W. B. JOHNSON, C.E., brought before the notice of the meeting the extraordinary advance that had been made within the last twenty years in the capabilities of machines for cutting and paring heavy articles of machinery, and said this was particularly noticeable in the treatment of heavy forgings. At no very remote date it was the universal practice to pare down heavy forgings to something near the finished dimensions in the smithy by hand labour only; this mode of procedure was not only expensive, but rude and imperfect in its results. The introduction of tools to supersede the use of the hand chisel and file in the workshop has been developed to a remarkable degree. Machines are now made of such enormous strength, and the cutting tools so carefully devised, that the old system of paring down in the smithy has been set aside; this competition between the tools of the workshop, and the handwork of the smithy has resulted in establishing the system of tool paring in preference to smith-work to an almost universal extent. Twenty years ago there might be seen in engineering establishments a large smiths' fire. in which was placed a part of some heavy forging, and when the part under operation was heated to a blood-red heat, the superfluous parts were cut off by means of a set, upon which the successive blows of four and sometimes six strikers were delivered with surprising precision and regularity, and by these repeated heatings and dressings the forging would be eventually brought down to its finished dimensions, except by so much as was necessary for the final finishing or getting up. These operations in the smithy, as before observed, have now ceased; the forgings are taken at once and placed in a machine, which, by heavy and continuous cutting, soon pares down the forgings, and then finishes them without changing them to another machine or process. Tool paring is not only economical of labour, but the result as to accuracy is more satisfactory. Mr. Johnson then showed to the meeting some specimens of steel and iron parings sent to him by Messrs. Smith and Coventry, machinists, Salford, and further remarked that these parings demonstrated very clearly the capabilities of the machines and cutting tools of the present day. One specimen from a Bessemer steel shaft, the result of taking a cut $\frac{1}{8}$ths of an inch deep by $\frac{1}{8}$ths of an inch traverse, was particularly interesting on account of the form and size in which they, the parings, left the cutting tools. The cutting tools used in obtaining the specimens exhibited to the meeting were of a peculiar construction, and possessed some marked advantages over those in ordinary use.

On the Temperature Equilibrium of an Enclosure containing a Body in Visible Motion, by BALFOUR STEWART, LL.D., F.R.S.

It has been established that in an enclosure containing bodies which are all at the same temperature, and at rest, the same amount of heat enters any surface forming part of the walls of the enclosure as leaves it in the same time, so that the body, of which this is the surface, neither gains nor loses heat. It is also known that if we take not the outer surface of such a body, but any plane passing through its substance, say, for instance, one parallel to its outer surface, then as much heat passes across this plane going into the body as passes across it going out of the body in the opposite direction; and further, this equilibrium of heat is known to hold separately for every one of the individual rays of which the whole heterogeneous radiation is composed.

The effect of the motion of the body in altering the wave-length of the radiated light is also well known. In consequence of this, if a cosmical mass, such as a star or nebula should be formed of incandescent hydrogen, and be at the same time rapidly approaching the earth, the light which strikes the earth will not be the double line D, but a line more refrangible than it, and therefore this light will be able to pass through a mass of ignited sodium vapour at the earth's surface without suffering absorption, while, however, the light emanating from the sodium vapour will still be the double line D.

In such a case, even if the star and the terrestrial sodium vapour should both be of the same temperature, yet the light radiated by the latter will not be the same in quality as that absorbed. This instance would appear to show that the equilibrium which holds in an enclosure of uniform temperature when all the substances are at rest does not hold when some of these are in visible motion, and that if in that enclosure there be a body moving towards or from the surface of the enclosure, the heat which enters the surface from the moving body will not be the same as that which the surface gives out.

Suppose, for instance, that the walls of the enclosure are made of glass, and the temperature of the whole enclosure, including that of the moving body, is 0° C., then, were the whole at rest, the heat which strikes the glass surface will all be absorbed at a very short distance below the surface, and in like manner the heat radiated by the glass will all emanate from a short distance below the surface. But let us now suppose, to take an extreme case, that the moving body is approaching one of the glass surfaces so rapidly that the heat which it emits has been so much increased in refrangibility as to enter the boundary of the visible spectrum.

Then while the heat radiated by the glass will still continue to proceed from a very short distance beneath the surface, the heat absorbed by the glass from the moving body will be able to penetrate to a very considerable depth beneath the surface of the glass.

The outer layer of glass will thus lose, while the inner layer will gain, heat.

Now, it is possible to conceive an enclosure with a fixed diaphragm, and containing a revolving body, so arranged that the heat which leaves it in the direction of a certain part of the enclosing surface, shall always be given out by that part of the revolving body which is moving towards the surface; while, on the other hand, the heat given out by the revolving body to another surface shall be given out when the revolving body is moving from that surface.

There will thus be a want of temperature equilibrium among the various layers, those near the surface being somewhat different in temperature from those beneath. But when we have a temperature difference of this kind, have we not acquired the power of converting heat into work? It would thus appear, at first sight, that the mere presence of a moving body has given us the power of obtaining work from an enclosure, all of whose particles were originally at the same temperature. This appears, however, to be opposed to the theory of the dissipation of energy, and in consequence we are induced to think there must be some error in the assumption.

Now, does not the unwarranted part of the hypothesis consist in our supposing that the revolving system can continue to revolve without losing part of its visible motion?

When two moving bodies approach or recede from each other, is it not possible that each loses a small part of its visible energy while at the same time there is a surface disturbance produced in both?

It might be said that believing in a medium pervading all space we were prepared for a stoppage of motion of this nature, and that there is, therefore, nothing gained

by the supposition which has been made; but it might be replied that, by looking at the problem in the above light, we appear to connect this stoppage of motion with other facts, besides being made aware of a source of surface disturbance when cosmical bodies approach or recede from each other.

Postcript, added November 19th.—If we imagine a stoppage of the motion of cosmical bodies of the nature above described, then if the two approaching bodies be exactly equal and similar, either extremity of the medium between them will be similarly affected by the motion derived from the approaching bodies; but if these bodies are unequal, the two extremities of the medium will be dissimilarly affected.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 7th, 1870.

Joseph Baxendell, F.R.A.S., President of the Section, in the Chair.

Mr. Baxendell reported that, in accordance with a wish expressed by the Council of this Section, the Parent Society had agreed to an alteration of the rules respecting the admission of Associates to the Section; in future the subscription for Associates, with the present privileges, will be 10s. per annum, and to those paying a subscription of 20s. per annum, the right of taking books out of the library will be accorded.

Mr. Spencer Bickham, jun., called attention to the very serious inconvenience that was experienced by all having occasion to distribute Natural History specimens, owing to the recent prohibition of the authorities to allow such parcels to be transmitted by "sample post," and it was agreed that a memorial be forwarded to the Postmaster General.

LONDON INSTITUTION.

On Thursday evening, November 24th, Professor Morris, F.G.S., delivered a lecture "*On the Precious Metals and their Distribution.*" The chair was occupied by Mr. H. W. Field, F.C.S., Resident Assayer at the Royal Mint, and many other gentlemen interested in the working and manufacture of the precious metals were among the audience. In the first part of his lecture, Professor Morris brought forward a vast array of facts relating to the use of gold and silver by the ancients, particularly the Egyptians, who seemed to have obtained their supplies of the former metal from Nubia. The lecturer dwelt at length on mode of occurrence of the precious metals, their geographical range, geological position, and economic uses, illustrating his remarks with maps, models of nuggets, and numerous beautiful specimens of native gold. In discussing the geology of gold, he said that this metal was found distributed through rocks, quartz veins, or alluvial deposits. The Silurian rocks, and the granites associated with them, furnished the greater quantity, but the cretaceo-oolitic rocks of Peru, Bolivia, and California when, traversed by dioritic igneous rocks, were also auriferous, showing, according to Mr. David Forbes, that there were too well-marked epochs of gold intrusion. From both formations, but specially from the Silurian, the gold found in alluvial deposits is derived, the auriferous rocks having undergone erosion to an enormous extent at a comparatively late geological period, namely, the Newer Pliocene. The remains of extinct mammalia, discovered in the deposits of the Urals, and also in those of Australia, had satisfactorily fixed their geological age. In noticing the more important points connected with the gold coinage, Professor Morris referred to the remarkable brittleness of gold alloys containing minute quantities of palladium.

On Monday afternoon, November 28th, Dr. Odling delivered the fifth lecture of his educational course, "*On Chemical Action*," to a crowded audience, comprising a large number of boys and girls from the schools of London and its environs. In this lecture the chemistry of burning or destruction was entered on, and almost every fact brought forward was the subject of a striking experiment.

CORRESPONDENCE.

ON THE MAGNETIC POWER EVOLVED BY A GALVANIC BATTERY.

To the Editor of the Chemical News.

Sir,—In your journal of the 28th ult. (Chemical News, vol. xxii., p. 205), there was an abstract of a paper by the Rev. H. Highton, "On the Maximum of Magnetic Power Evolved by a Galvanic Battery." In that paper Mr. Highton says—"Can we, then, get infinite power out of a finite source of force? Yes. But on this condition, that what we gain in power we lose in time; for the current would take twice as long to traverse the second circuit, and therefore it takes double the time to produce double the magnetic power. But the electric current is so rapid that this difference of time is inappreciable within any practical limits." It appears to me that this last sentence entirely nullifies the previous remark, that "what we gain in power we lose in time"; in other words, I understand Mr. Highton to assert that we can obtain infinite power out of a finite source of force. Does Mr. Highton attach different meanings to the terms "power" and "force"? These terms are usually considered to be synonymous. If they are, the above statement is a logical contradiction in itself; if, in Mr. Highton's opinion, they are not synonymous terms, might it not be advisable for him to define what are his conceptions of the meanings of the terms "power" and "force"?

In another place, speaking of doing work, Mr. Highton says—"But this work is being done every time that the circuit, after being broken, is closed; and the circuit may be broken and closed so many times a second, that the number is practically illimitable, and hence the amount of work that can be done by a given battery is illimitable. The only question is a question of first cost of machinery."

Now I presume that Mr. Highton means, by a "given battery," one capable of distributing a definite quantity of force. Referring to the above paragraph, it would appear that the source of force (the battery) was governed solely by the operation of breaking and closing the circuit. Is the magnet itself a progenitor of force? Mr. Highton does not say.

Furthermore, is Mr. Highton aware of the fact that, in practice, it is found that a "given battery" will not supply the requisite amount of force for an unlimited quantity of magnetic machinery? Possibly I have misunderstood Mr. Highton's statements; but, as the subject is of great interest, I should feel obliged if you would insert this letter in your valuable journal.—I am, &c.,

Robert Spice.

40, Cirencester Place, W.,
Nov. 17th, 1870.

ON THE MAXIMUM OF MAGNETIC POWER EVOLVED BY A GALVANIC BATTERY.*

To the Editor of the Chemical News.

Sir,—I gladly avail myself of the opportunity afforded me by Mr. Spice's letter, which you have kindly communicated to me, to enter more fully and deeply into the question raised by me in my paper read before the British Association.

Let me first, then, define what I mean by "force" or "power," which, as Mr. Spice justly observes, are synonymous. I will define, then, in this connection, the

* To save time, Mr. Spice's letter was forwarded in proof to Mr. Highton, and we are thus enabled to lay before our readers this reply.

amount of magnetic force or power to be "the number of units of weight which the magnet will raise through a unit of height." In the case of a magnet, the unit of height taken should be small, because the power varies considerably (generally inversely as the square) at different distances. I might define magnetic force to be the amount of weight which a magnet will sustain, which is in proportion to the weight raised through a unit of height, but it might be objected that this is only a static, not a dynamic, force. It might be defined in many other ways, but I think this will answer the purpose and be as simple as any. It might be measured by the method of torsion, or the number of oscillations caused in a second in a magnetic needle. While I am giving definitions, let me say that by "a given battery" I do not mean "one capable of distributing a definite quantity of force," for that involves the very question at issue; but I mean a battery of a given number of cells, with elements of a given size and of a given material, at a given distance from each other in a given electrolyte; and by the maximum of magnetic power evolved by it, I mean the maximum power evolved by a given consumption of zinc or other positive element. It has always been assumed, as a kind of axiom, that a given battery, by a given consumption of zinc (or a given amount of chemical change), can only produce a certain maximum of force. Now the question I wished to raise was whether this was true; whether facts, and the ordinary accepted laws based on facts, did not show that a given amount of chemical change could, by skill, be made to produce any amount of force whatever. I do not care to defend the suitability of the terms or manner in which I expressed myself in the abstract of my paper read at the last meeting of the British Association; but what I do wish is to raise this grand question.

I am quite aware that, at present, the majority of the scientific world would at once decide in the negative *à priori*—and perhaps refuse even to discuss it. But it is a question, not of preconceived theory, but of fact. When Galileo dropped weights of one pound and ten pounds from the tower of Pisa, and the sound of their collision with the ground rung on the ear simultaneously, the scientific men of the day refused to believe their senses, because Aristotle had shown that a ten-pound weight must fall ten times as fast as a one-pound weight. But facts have since proved too strong for theory. I freely confess that I was indistinct and obscure in my mode of expressing myself in the paper above mentioned, and therefore let me now state distinctly that what I wish to assert, as at present advised, is that a given amount of chemical change can be made (I do not say economically or conveniently, but *can* be made) to produce an unlimited amount of force. I wished in the reasoning and experiment given in that paper to show that whatever amount of force a battery was producing, that amount might be doubled or, in fact, increased indefinitely.

To simplify the matter, let me take the simplest possible case. Take a battery with an exterior circuit consisting of one electro-magnet, which shall be capable of sustaining n pounds when the circuit is closed. Then I assert that if for the one electro-magnet n electro-magnets be substituted, and the current passed in succession through them, each electro-magnet will sustain one pound, and also that if in the first case the battery were consuming n grains (or other units) of zinc per second, it will now only consume one grain, so that the consumption of one grain of zinc will now produce as much force as n grains did before. I may say, indeed, that, as a matter of fact, each magnet in the second case will sustain rather more than one pound, for, on account of reasons which it is not worth while here to enter into, the magnetic force will decrease rather less than in proportion to the intensity.*

* I have since found this to be strictly true only when the experiment was tried under certain conditions. What is strictly true is, that the power of the wire to act on a magnet follows this rule. The actual *weight* sustained by a magnet depends on numerous subsidiary conditions.

But, to probe the matter to the bottom, we must divide the time during which the battery acts into three periods, and describe what takes place during each. (1) The time which it takes the electric force to traverse the circuit after it is closed. This in ordinary cases is infinitesimal; but where the circuit is very long, and where there is much inductive as well as conductive resistance, as in the Atlantic Telegraph, the time becomes very appreciable. But I would remark that the expenditure of zinc during this first period is occupied in producing a state of tension in the conductor which, theoretically speaking, forms a store of available force that may afterwards be recovered. (2) There is the period during which the magnet is pulling its keeper to itself, and is positively doing actual work. Now, paradoxical as it may seem, it is a fact that during this period (No. 2), while the magnet is doing actual work, the intensity and the consumption of zinc is actually diminished, so that, in one sense, the more work done the less the fuel (so to speak) which is consumed in doing it. It is in this point that a galvanic battery differs from other machines which do work. It is as if a horse, when he did work, ate actually less food than when he was idle, and wasted less muscle, or as if a locomotive consumed less fuel when in motion than when at rest. (3) Then comes the third period, when the keeper has been pulled home, and the weight is merely sustained. During this period no actual work is being done, and the weight sustained only shows what work the magnet is capable of doing, and so serves as a measure of its potentiality, and during this period (No 3), strange to say, more zinc is consumed per unit of time than while the work is being done. In practice, therefore, in an electro-dynamic engine, period 3 should be reduced to *nil*.

Now break the circuit. If there be a secondary wire (as in a Ruhmkorff coil) the tension produced during the first period may be utilised in some way by the counter current produced in thus breaking the circuit, and the same series of phenomena may then begin over again.

What I contend, then, is briefly this (and I will put the matter as distinctly as I can)—that though by lengthening the circuit we prolong the time (period No. 1) which elapses before the magnetic force begins to act, we nevertheless, out of the same consumption of zinc, get an indefinite increase of the force produced. And here let me add that if an electro-dynamic engine were made to act by producing continuous rotation without alternately breaking and closing the circuit, period No. 1 would only come once during the time the engine was at work.

This conclusion of mine may appear paradoxical, but I believe it to be true, both because well-known laws lead logically to it, and because I have found the fact confirmed by experiment. There is one analogous case perhaps still simpler. Take a battery, insert in the circuit a voltameter with silver electrodes, and containing solution of nitrate of silver. Now separate the electrodes to a distance from each other n times as great as before. This will simultaneously diminish the intensity and the consumption of zinc, but the result will be that the consumption of one equivalent of zinc will convey an equivalent of silver over n times the distance it did before; or if the size of the plates of the battery and of the electrodes be increased severally n times, so as to make the intensity the same as at first, one equivalent of zinc will convey one equivalent of silver n times the distance it did before and in the same time.

One word more, though this letter is already too long. But the subject is important, and it is impossible to be at once full and concise. If the magnetic power of a battery is not illimitable, what is its limit? Let some one give me a reply. The only reply I can find is a statement that the greatest amount of energy is produced in the exterior part of a battery circuit when the exterior and interior resistances

are equal.* Now, in the first place, this can only be true in any case when we do not take into account the amount of zinc consumed, and in the second place it is only true of the *heat* produced, and it is assumed that all other kinds of energy are in proportion to the heat, than which I venture to say no greater error has ever obtained so wide a credence in an age of critical science. If it were true, all our galvanometers should be formed with short lengths of as thin wire as possible, and our electro-magnets and helices should also be made with very thin and very short wires, which every one knows in practice would be absurd.—I am, &c.,

H. Highton.

Putney, Nov. 22nd, 1870.

PS.—In my letter written to you last week, and in a paper read to the British Association, I maintained that the negative force to be derived from a grain of zinc was without limit.

I gave experiments which proved this, for I showed how a definite force could be got from an indefinitely diminishing consumption of zinc, or an indefinite increase of power from the same consumption.

In fact, my experiments, when I tried them, proved more than this, for, having first found that a battery working a magnet sustained 8 lbs., I made it support 9 lbs. with half the consumption of zinc. I also found an equal consumption of zinc supported 18 lbs. by mere alteration of arrangements. As other people may repeat the experiments and find them fail, I may say that I have since found that the particular alterations of arrangements here described, though answering in that particular case, will by no means answer in all cases. The laws of magnetic power vary so very much in different condition of sizes of wire, dimensions of iron core, and battery strength—conditions which can only be learnt by an immense variety of experiments, that it requires a very special and particular knowledge and experience to apply the particular expedients required under varying conditions.

Nevertheless, in all cases the difficulties may be got over by skill, and the truth, theoretical and practical, remains the same, that the magnetic power of a battery may be increased without limit.

The magnetic power of a circuit is always measured (according to varying conditions) by some power or other of $l \times i$, l being the length of wire outside the battery, and i the intensity of the circuit, and as $l \times i$ may be increased without limit, the magnetic power may be increased without limit. How to vary l and i to the greatest advantage under varying circumstances is the problem which exercises the skill of the engineer. This I may safely say, that never yet has any electro-motor been constructed with a real knowledge of the scientific problem to be solved. I propose shortly to discuss Jacobi's paper on the subject written in 1850 which still remains the great authority, but which is full of errors.—H. H.

PURIFICATION OF SYRUPS.

To the Editor of the Chemical News.

Sir,—Although I am in no way called upon to act as champion for Dr. Seyferth and his process, yet I think it is only right to state that Dr. Calvert, in his letter in your last impression, seems to have misunderstood the claim Dr. Seyferth is putting forth. He cannot, and does not, claim to be the first inventor of a sulphurous acid process for the purification of syrups, for already, as far back as 1849, M. Melsens published such a process, which at once raised a great deal of attention on the Continent. I 1858, Dr. Calvert and M. Sievier came out with their plans, and in 1863, the processes of Reynoso, and especially of Possoz and Perier, produced the greatest sensation among German sugar manufacturers. I may safely say that there is not one of the latter class who is not acquainted with this subject, and a gentleman of Dr. Seyferth's attainments would have all these processes at his fingers' ends—among them also Dr. Calvert's, which is quite well known in Germany, as far as published. The feature Dr. Seyferth is claiming as a new one is evidently only the way of employing the sulphurous acid solution, viz., by sucking it up into the vacuum pan along with the syrup; he distinctly states that only by using it in the vacuum pan it can be completely removed again. This seems to be new, and a *prima facie* argument for the real novelty of the process is this, that it has been so warmly recommended by the German Association of Beet-root Sugar Makers, which commands *savans* of the most extensive knowledge of everything published in the matter of sugar making and refining. Without, therefore, taking away from Dr. Calvert's merits, I think Dr. Seyferth has other merits of his own.—I am, &c.,

George Lunge.

PRESERVATION OF STONE.

To the Editor of the Chemical News.

Sir,—In his letter which appeared on the 18th of November, Mr. Spiller seems to have completely disposed of his own claim to the superphosphate process, by allowing Coignet's prior use of this method to render a calcareous cement non-absorbent. In both cases the same solution is employed for the same purpose, and with the same result, namely, the conversion of calcium carbonate into tricalcic phosphate by means of a solution of monocalcic phosphate. I take for granted, from Mr. Spiller's silence on the point, that he has abandoned his solution of superphosphate mixed with a little baryta, the really original part of his method.

The legal questions as to patents which Mr. Spiller raises I do not feel to be within my province to discuss.—I am, &c.,

A. H. Church.

Royal Agricultural College, Cirencester, November 28th, 1870.

MISCELLANEOUS.

The Royal Society.—The annual meeting of the Fellows of this Society was held on the 30th ult., at Burlington House. The President, Lieut.-General Sir Edward Sabine, K.C.B., &c., delivered the inaugural address, in which he reviewed the progress which had been made in science during the year. In closing his address Sir E. Sabine announced his intention not to offer himself for re-election at the next anniversary, when, to quote his words, he "will deliver over the chair, doubtless to a younger, it may well be to a worthier, occupant; it can hardly be to one having the welfare of the Royal Society more warmly at heart,"—a sentiment which was cordially echoed by all present. The presentation of the medals followed:—The Copley Medal was awarded to Mr. James Prescott Joule, F.R.S., for his experimental researches on the dynamical theory of heat; a Royal Medal to Professor William Hallowes Miller, Foreign Secretary R.S., for his researches and writings on mineralogy and crystallography, and his scientific labours in the restoration of the national standard of weight; a Royal Medal was also awarded to Mr. Thomas Davidson, F.R.S., for his works on the recent and fossil Brachiopoda, more especially his series of monographs in the publications of the Palæontographical Society; the Rumford Medal to M. Alfred Olivier Des Cloizeaux, for his researches in mineralogical

* I have tried to trace this strange error, which is committed, I find, by Jacobi, De la Rive, Du Moncel, by Professor Foster in the "Chemical Dictionary," and I have no doubt is copied in all our text-books. In some cases I find it deduced from the law of the maximum of heat; in the case of Du Moncel it is due to a most remarkable mistake in an algebraical formula.

optics. The following gentlemen were then elected officers and council for the ensuing year:—President, General Sir Edward Sabine, R.A., K.C.B., D.C.L., LL.D.; Treasurer, Mr. William Spottiswoode, M.A.; Secretaries—William Sharpey, M.D., LL.D.; Mr. George Gabriel Stokes, M.A., D.C.L., L.L.D.,; Foreign Secretary, Professor William Hallowes Miller, M.A., LL.D. Other member of the Council:—George Burrows, M.D.; Mr Heinrich Debus, Ph.D.; Peter Martin Duncan, M.B.; Sir Phillip de M. Grey-Egerton; Professor George Carey Foster, B.A.; Mr. Francis Galton; Mr. John Peter Gassiot, D.C.L.; Joseph Dalton Hooker, C.B., M.D.; Mr. William Huggins, D.C.L., LL.D.; Professor George M. Humphry, M.D.; Mr. John Gwyn Jeffreys; Sir John Lubbock; Mr. Charles William Siemens, D.C.L.; Professor Henry J. Stephen Smith, M.A.; Professor John Tyndall, LL.D.; Professor Alexander W. Williamson, Ph.D. After the meeting the Fellows and their friends, including Mr. Gladstone and the Lord Chancellor, dined at Willis's Rooms, the President occupying the chair.

The Purification of Paraffin.—The Mineral Oil Company (Mineralöl Verein), of Halle, in Prussia, offer two prizes of 5000 thalers for the solution of the two following technical questions. The one is, to find a chemical means of purifying crude pressed cake paraffin with the least possible loss, which must not exceed 5 per cent. The other is, to devise a method for cooling masses of paraffin to a temperature of at least 5° C. at any season of the year. Among the materials for the purification of the press cake, colourless oil of tar, benzol, and all like substances which exercise a solvent action on paraffin, are forbidden to be used. The loss of paraffin, when press cake free from dirt is operated on, must not exceed 5 per cent; the process of purification must be rapid and easy of application, and must not be attended with any considerable cost. The refined paraffin is to have a bluish-white colour, and must be colourless. The process for cooling masses of paraffin must admit of 500 cwt. of material being cooled each day, in vessels containing 5 cwts. each, to a temperature of at least 5° C., the cooling to take place either in one place or several. It would be preferable for this to be brought about by cooling the room in which the paraffin candles are left to crystallise. The cooling of the material must be brought about gradually, and in such a manner that the formation of crystals, in respect to their constitution and magnitude, be in nowise interfered with. The answers must be sent in by the 1st January, 1871, and they will be considered by a commission appointed by the Mineral Oil Company of Halle, and composed of Mr. Riebeck, of Halle; Bergrath Bischoff, of Weissenfels; Dr. Rolle, of Gerstewitz; and Dr. Hübner, of Zeitz. In the event of competition, the prize will be awarded to the proposer of the most advantageous solution to the question.—*Journal of the Society of Arts.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Polytechnisches Journal von Dingler, second number for October, 1870.

This number contains the following original papers and essays relating to chemistry and collateral sciences:—

New Aneroid Barometer for the Barometrical Determination of Heights.—J. Goldschmid.—This paper contains the description, illustrated by a series of engravings, of an improved and accurate aneroid barometer, which is better fitted for the measurement of mountain heights and elevations above sea level generally.

Convenient Alteration in the Arrangement of Bunsen's Galvanic Battery.—Dr. D. Laschinoff.—This paper, treating on an improved arrangement of Bunsen's galvanic battery, cannot be usefully abstracted without the reproduction of a series of engravings.

Description of an Apparatus Contrived for Exhausting Substances.—F. R. von Schwind.—This paper, illustrated by a series of woodcuts, contains the detailed description of an improved apparatus contrived for the purpose of extracting salts soluble in water from insoluble or more difficultly soluble materials.

Enamelling of Iron.—Dr. E. M. Dingler.—The author first points out that the main difficulty in the process of enamelling iron consists in the fact that the expansion of the metal by any increase of temperature is far greater than the expansion of glassy bodies, and that, as a consequence, the enamel is very liable to come off by a sudden increase of the temperature of the enamelled metal. This defect, says the author, is best mended by the use and application of a ground, or first layer, which does not become quite fluid by heat, but retains a pasty consistency and porosity, which enable it to give way to some extent by the expansion. On this first layer, the second, or covering layer, is applied. The author recommends the following mixture as ground or first layer:—Pulverised quartz, 30 parts; borax, 16½; white-lead, 3 parts. These ingredients are fused together, and the molten mass is pulverised and intimately mixed with 9 parts of very finely ground-up quartz, 6⅔ parts of washed pipe-clay, and ½ part of magnesia alba. The second, or covering layer, is prepared by melting together a mixture of 37½ parts of pulverised quartz, 27½ of borax, 30 of oxide of tin, 15 of carbonate of soda, 10 of nitrate of potassa, and 5 parts of magnesia alba. The molten mass is poured into water, and afterwards mixed with 6½ parts of powdered quartz, 3⅔ of oxide of tin, ⅔ of carbonate of soda, and ⅔ parts of magnesia alba, and the whole of the ingredients very finely ground along with water, so as to constitute an impalpable powder. The metal to be enamelled is first cleaned with dilute sulphuric acid (1 part of strong acid to 24 of water), then rubbed with sharp sand, rinsed in hot water, and immediately afterwards dried; the enamel masses are next burnt on. Well made enamel exhibits the following characteristics:—A perfectly smooth and level surface, so that the surface nowhere feels uneven or rough to the touch; a pure white colour; absence of small cracks.

Contribution to our Knowledge on Chlorimetry.—Dr. C. Winkler.—This very lengthy essay records a series of experiments instituted by the author to test the accuracy of Dr. R. Wagner's method of the estimation of chlorine contained in bleaching-powder (hypochlorite of lime); also as compared with the methods of MM. Penot and Mohr. The method of Dr. R. Wagner is based upon the decomposition of a certain volume of a solution of hypochlorite of lime, by means of the addition thereto, first, of iodide of potassium, and next of dilute hydrochloric acid, and estimation of the quantity of iodine set free by means of a titrated solution of hyposulphite of soda. Dr. Wagner recommends to take 1 grm. of hypochlorite of lime to 100 c.c. of water, 2·5 grms. of iodide of potassium dissolved in 25 c.c. of water, and to add dilute hydrochloric acid until an acid reaction is apparent (this method is described at length in Dr. Dingler's *Polytechnisches Journal*, vol. cliv., p. 146, 1859). The exhaustive researches of the author of this paper prove that this method is, when executed with care, very correct in its results and thoroughly reliable in practice.

Abnormal Behaviour of Mahrenberg Magnesite.—Dr. H. Schwarz.—While engaged in making some experiments on the manufacture of the Sorel magnesia cement (viz., calcined magnesite mixed with a solution of chloride of magnesium), the author applied for that purpose the magnesite of Mahrenburg (Styria); but, finding that it did not become a hard mass, he analysed this mineral, and found it to contain, in 100 parts—Carbonate of magnesia, 92·52; carbonate of lime, 3·55; carbonate of protoxide of iron, 3·79; insoluble sand, 0·14. At first, the author ascribed the non-hardening of this magnesite, after having been calcined, to the presence therein of carbonate of lime and oxide of iron; but, on making an experiment with amorphous magnesite from Friedau, which contains, after calcination, 2·38 per cent of lime and 0·43 per cent of oxide of iron, it became evident that these impurities did not interfere with the hardening. The author explains the difference by the fact that the Mahrenberg magnesite is a crystalline substance, and stands to the Friedau and Frankenstein magnesites (both amorphous, and the latter especially a very pure material) in the same relation as calc spar (Iceland spar) to arragonite, a view which was proved to be correct by taking the specific gravities of the various magnesites alluded to.

On Wocheinite.—Dr. H. Schwarz.—Under the above name, derived from a locality in Austria, the author gives an account of some experiments made with a hydrate of alumina found in the Wochein, and akin to the Bauxite. This wocheinite consists, in 100 parts, of—Alumina, 56·82; silica, 11·28; peroxide of iron, 1·60; water, 24·20; traces of carbonate of lime and of manganese. The mineral is suitable for being mixed with other fire-clays (it is not sufficiently plastic by itself even when pulverised), and for the manufacture of aluminate of soda and other salts of alumina.

Manufacture of Chromate of Potassa.—Dr. H. Schwarz.—After referring, at some length, to the well-known method of the preparation of chromate of potassa on the large scale, the author relates a few laboratory experiments made with the view to test whether there is any necessity for using, as is usual on the large scale, sulphate of potassa along with the chromate of iron and lime. The result of the author's experiments is, that, when a mixture is made of 1 equiv. of oxide of chromium and 2 equivs. of lime, and these substances very intimately mixed and heated in a muffle, there is obtained a bright yellow-coloured powder, which contains as much as 85 per cent of the oxide of chromium used in the state of chromic acid. The author comes to

the conclusion that the sulphate of potassa is not necessary in the mixture during ignition, and that the chromate of lime formed during the ignition may be advantageously decomposed by bisulphate of potassa, according to the formula—

$$2(CaOCr_2O_3)+KaO_2SO_3=KaO_2Cr_2O_3+2(CaOSO_3).$$

Decomposition of Chloride of Potassium by Sulphate of Magnesia.—Dr. H. Schwarz.—This paper contains the record of a series of experiments made with the view to elucidate the various reactions and formation of double salts which are observed to take place when equivalent proportions of chloride of potassium and sulphate of magnesia are mixed together, having been previously dissolved separately in water. In the first place, there is formed, under these conditions, the well-known potasso-magnesia double salt. This salt having been re-crystallised from a quantity of water, insufficient for its solution, the author obtained—(1) a residue of pure sulphate of potassa, containing 46·07 per cent of sulphuric acid, instead of 45·42, as required by theory; (2) the solution yielded on first crystallisation, $KOSO_3,MgSO_3+6aq$, containing, in 100 parts, 39 per cent of sulphuric acid; (3) the second crystallisation yielded a salt wherein the sulphate of magnesia predominates, and consisting, in 100 parts, of 25·12 of sulphate of potassa, 36·21 of sulphate of magnesia, and 38·65 of water, of which 32·49 per cent is eliminated at 100°, and 5·66 by ignition.

Acid Nature of the Organic Matters present in River and Spring Water.—F. Stolba.—The author states that, according to his experience, obtained by making (in Bohemia) a large number of water analyses, all waters which contain a large proportion of organic matter contain it in combination with bases, chiefly lime, and that, therefore, the organic matter is (as already suggested, and partly experimentally proved by Berzelius) of an acid nature.

Simple Method of Detaching Paint and Lacquer-Work from Tinned Iron.—Dr. H. Emsmann.—This method comes virtually to the use of mercury, or of a piece of wash-leather impregnated with that metal, after a slight portion of the paint or lacquer has been first removed from the tinned iron by mechanical means.

Preparation of Condensed Milk.—Dr. Trommer.—A lengthy essay on this subject, but not suited for useful abstraction.

Artificial Formation of Graphite.—Dr. R. Wagner.—After briefly alluding to some reactions by which the origin of native graphite might be referred to the decomposition of cyanogen compounds, and stating that the black mass often observed as the result of the slow and spontaneous decomposition of hydrocyanic acid is, after having been boiled with nitric acid, found to consist of a graphitoid body, the author first directs attention to the formation of graphite in the blast-furnace process, and next states that M. Max Schaffner, director of the chemical works at Auszig (Bohemia), has succeeded in preparing graphite, fit for the making of lead-pencils, as a by-product of the manufacture of soda as carried on by Leblanc's process, the graphite being, in this instance, due to the splitting-up of the cyanide of sodium in a peculiar manner.

Loss of Weight Platinum Crucibles Suffer by being Continually Ignited.—Dr. F. Stolba.—The author has made a series of experiments on this subject, the results being that the rougher and more unpolished the surfaces of platinum crucibles are, the more readily they are acted upon by the flame of well-made Bunsen-burners, because the rough unpolished surface promotes the formation of a compound of carbon and platinum, which is partly consumed by the flame, partly mechanically carried upwards in the hot current of air, after having been detached from the crucible. The author found, by experiment, that, when a good platinum crucible was heated for twelve hours continually, it lost 0·016 grm. in weight, and its surface appeared as if etched, or as the well-known *moiré métallique*. This loss and alteration are not due to the presence and subsequent elimination of osmium, because the loss is greater of the crucible than the quantity of osmium contained in crude platinum. The brighter and more polished the surface of platinum crucibles and other platinum vessels exposed to ignition is kept, the better they will resist the deleterious action of the flame.

Simple Method of Obtaining Sea-Sand Fit for Cleaning and Polishing Platinum Crucibles.—Dr. F. Stolba.—Since the author resides at Prague (Bohemia), where, of course, sea-sand is not a material readily procured, he came upon the idea of applying to a sponge merchant, requesting him to beat some sponges and collect the sandy matter. In this way the author contrived to obtain a small quantity (some few drachms) of sea-sand, which he cursorily states to consist of about 80 per cent of carbonate of lime and 20 per cent of pure quartzose sand.

Behaviour of Silico-Fluoride of Potassium with the Blow-pipe-Flame.—Dr. F. Stolba.—This salt, exposed to the blowpipe-flame on a piece of platinum wire, fuses at a moderate heat to a bead, which, while hot, is transparent, but becomes enamel-like on cooling. Continued heating causes the evolution of fluoride of silicium, whereby the bead shrinks, and yields, after cooling, a clear, transparent glass, which, having been qualitatively tested, was found to consist of fluoride of potassium and of silicate of potassa. The bead alluded to is, says the author, a very suitable substance for blowpipe tests. Silico-fluoride of sodium does not yield a transparent bead at all.

Analysis of Alabaster Glass.—Dr. F. Stolba.—This glass was that of a broken lamp-shade. It was very hard, and contained in 100 parts—Silica, 82·3; alumina, 3·2; lime, 3·3; potassa, 5·66; soda, 5·60. Fluorine, oxide of tin, phosphoric acid, and arsenic acid were not present.

Crystallisation of Chlorate of Potassa by Fusion.—Dr. F. Stolba.—When a tolerable quantity of this salt is cautiously fused in a large platinum crucible, and after being slowly cooled, the surface, previous to its becoming quite solid, is pierced with a piece of thick platinum wire, and the still fluid mass poured out, the crucible will be found lined with crystals, which, according to the author, are of the same shape as those exhibited by the salt when crystallising from its aqueous solution.

Analysis of a Peat-Ash from Benatek (Bohemia).—Dr. F. Stolba.—The peat alluded to leaves from 20 to 22 per cent of ash, consisting, in 100 parts, of—Soluble in hydrochloric acid: Sulphate of lime, 20·45; carbonate of lime, 17·27; caustic lime (Aetzkalk), 22·40; magnesia, 0·47; alumina and oxide of iron, 13·35; sulphuret of calcium, 0·74. Insoluble in hydrochloric acid: Lime, 0·84; magnesia, 0·06; alumina and peroxide of iron, 3·62; silica, 19·79; water and carbonaceous matter, 1·01.

Precaution to be taken when Paraffin is Applied as a Means of Preventing the Boiling Over of Fluids.—Dr. F. Stolba.—Since paraffin has very little, if any, affinity at all for acid and alkaline fluids, it is often used to prevent, in chemical operations, the boiling over of liquids. The author states that, while engaged in preparing sulphurous acid gas by heating copper turnings and strong sulphurous acid, he used paraffin to prevent that mixture (very apt to boil over in consequence of the tumultuous evolution of gas) from boiling over; but, after awhile, an explosion took place, caused by the fact that the gas delivery-tube had become choked by the paraffin, which in molten state had been mechanically carried over by the sulphurous acid gas, and, on cooling in the gas delivery-tube, stopped the exit for the gas, and thus caused the destruction of the apparatus. In case, therefore, paraffin is used in such operations, the gas delivery-tubes should be wide, and the operator should pay attention if any paraffin becomes deposited in the tube.

Manufactory of Peas-Pudding Sausages (Erbswurst) at Berlin.—Dr. Dingler.—It appears that a Berlin cook, named Grünberg, has recently discovered a process by which a preparation of peas may be made so as to keep without becoming sour, and the Prussian Government has bought the secret of this process from the inventor, for a sum of £5555. The Prussian War Office has created an establishment, at Berlin, capable of producing daily 75,000 sausages made of this preparation, which consists of a mixture of bacon, peculiarly-prepared pea flour, onions, and other ingredients, inclusive of salt. The sausages are sent away packed in boxes containing from 100 to 600, weighing 1 lb. each, which are destined as food for the armies, and only requiring to be boiled in water for a very short time to be ready for the use of the soldiers. The daily ration of each being 1 lb., a quantity quite sufficient for each man. This establishment, only working for the armies, costs daily about £6000.

Zeitschrift für Chemie von Beilstein, No. 16, 1870.

This number only contains one original paper:—

New Method of Quantitative Analysis.—H. Carmichael.—As far as it is possible without the reproduction of a number of woodcuts, essentially necessary for the proper comprehension of the contents of this paper, we will try to give an account of the author's method of analysis. In the introduction to his paper, the author animadverts upon the fact that, on an average, the results of percentically-quoted analysis, made by experienced analysts, vary from 99·17 to 100·67, a difference of 1·5 per cent; or, when 1·5 grm. has been taken and weighed off, and the weighings during the operations been carried to 0·0001 grm., a variation of 225 units. As to the causes of these irregularities, the author states that they are chiefly, if not solely, due to the manipulations, among which decantation is one of the principal sources of error. The author then proceeds to describe, and illustrates by woodcuts, a series of ingeniously-contrived apparatus, the object of which, chiefly, is to render such operations as decantation, filtration, drying, and ignition of substances, readily and very accurately-executable operations, the author states that even a couple of milligrms. of substance are sufficient for a complete analysis. The paper contains the following example of an analysis made by the author's method:—

	Quantities weighed off.	Found.
MgO	0·0690	0·0688
KCl	0·1873	0·1852
NaCl	0·0876	0·0900
	0·3439	0·3440

Without having seen this method, and the apparatus required, it is difficult to judge of its merits. It is very probable, however, that, if the author's process is found to answer as well as he leads us to believe, the apparatus will soon be obtainable from the dealers in such articles, who are generally men well enabled to judge whether a novelty will become generally available for use.

American Journal of Pharmacy, November, 1870.

This number contains the following original papers and memoirs relating especially to chemistry and allied sciences:—

Pulverisation of Camphor.—W. Procter.—It is well known that camphor is easily reduced to powder by rubbing with a few drops of alcohol, but the powder so made will, after a short time, aggregate to crystals, which have to be rubbed down again. The author mixes with the powder of camphor so obtained, carbonate of magnesia, 10 grains to the ounce being sufficient; this powder never cakes or forms crystals.

Crystallisation of Sulphocarbolate of Quinine.—Dr. C. J. Rademaker.—Crude sulphocarbolic acid was saturated with plumbic carbonate, the sulphocarbolate of lead crystallised and decomposed with sulphate of quinine, the solution of sulphocarbolate of quinine filtered and evaporated, but it was found almost impossible to crystallise the salt, owing to the gelatinous condition of part of the solution, which adhered to the small amount of crystals formed; the gelatinous mass was re-dissolved in alcohol, but with no better result as regards the obtaining of crystals. The author then made a solution of definite strength, and obtained, after a length of time (some few weeks), large crystals of prismatic shape, which on analysis were proved to be sulphocarbolate of quinine, a salt freely soluble in water, not deliquescent, and but slightly soluble in alcohol.

Amount of Arsenic in the Phosphorus of Commerce.—Dr. C. J. Rademaker.—Since the author had frequently to prepare dilute phosphoric acid, according to the directions given in the U. S. P., he states that he always takes the precaution of passing a current of sulphuretted hydrogen through the solution, in order to free it from all substances precipitable by that agent from acid solutions, the result always being that by this operation sulphide of arsenic is thrown down; in order to estimate the amount thereof, 100 grms. of phosphorus were oxidised with nitric acid, the solution diluted, and the arsenic precipitated as sulphide, AsS_3, by means of sulphuretted hydrogen; the solution was allowed to rest for six days after which the precipitate was collected on a filter and washed, transferred to a small evaporating dish oxidised with nitric acid, reduced by means of sulphurous acid to arsenious acid, again precipitated, but in the form of AsS_3, by means of sulphydric acid, the precipitate digested with ammonia to free it from adhering sulphur, the solution filtered, evaporated, dried, and weighed, and found to amount to 15 grains, or nearly 1 gramme of sulphide of arsenic.

Sulphocarbolate of Zinc.—Dr. A. B. Lyons.—The author first prepares crude sulphocarbolic acid by heating together 17 parts of strong sulphuric acid with 16 of carbolic acid; this mixture having been diluted with 10 times its volume of water is saturated with carbonate of lead; into the filtered solution of sulphocarbolate of lead, a quantity of pure granulated zinc, equal in weight to the carbolic acid employed, is introduced; at the end of 24 hours the solution will be usually found free from lead, giving no precipitate with sulphuric acid or potassium iodide; when the solution is in that condition it is decanted, heated to boiling, filtered, and evaporated to a small bulk to crystallise; the salt so prepared is quite free from sulphate, and yields fine large crystals free from any empyreumatic odour.

Solubility of Glue in Glycerine.—J. M. Maisch.—This paper contains a lengthy account of some experiments instituted by the author, who was called upon to act as expert in a suit involving the right to manufacture a composition for printing rollers in which sugar is wholly or partially substituted by glycerine, and since one of the attorneys (*Anglice*, "barrister"), engaged by one of the parties to the suit, stoutly denied the solubility of glue in glycerine, and said that this was the result of experiments made, the author set to work, and the results of his carefully made experiments may be summarised as follows:—Glue is soluble, at the ordinary temperature, in a large proportion of glycerine; glue is permeable by glycerine, slowly at ordinary, more readily at an elevated, temperature; glue swelled in consequence of the absorption of water remains unchanged in appearance under glycerine, that is to say, even if the glycerine should abstract the water, the former will take the place of the latter liquid, thus preventing the shrinking of the glue; glue, by continued digestion, dissolves completely in glycerine, gelatinising on cooling; the solution of glue in glycerine is accelerated by previous maceration in glycerine, and by increasing the temperature, and doubtless also by pressure; glue thoroughly permeated by water dissolves in hot glycerine about as readily as it does in hot water. The author throws out the valuable hint, that the property of gelatine of being soluble in glycerine might be turned to account to prepare a well-keeping standard solution of gelatine to be used for the assay of tannin-containing substances, since the aqueous solution of gelatine becomes very soon spoiled by standing after having been made.

NOTES AND QUERIES.

University of Giessen.—"Vox" wishes to know where he can ascertain the course for obtaining degrees at the University of Giessen.

Alkaline Fluorides.—I should feel greatly obliged if you would inform me how the solutions of neutral fluorides of the alkalies are made, as I want the above to etch glass with. In looking over past numbers I cannot find anything that treats of them.—O. X. O.

Dextrine—Lactic Acid.—(Reply to "Carbon.")—To estimate the quantity of dextrine in a solution likewise containing glucose, Dr. Gentele determines the total amount of these bodies by means of a standard solution of potassio-cupric-tartrate, and then estimates the glucose with an alkaline solution of ferricyanide of potassium (red prussiate) which does not act upon dextrine; the difference of the two determinations gives the quantity of the dextrine. Consult the article on "Dextrin" in Dr. Watts's "Dictionary of Chemistry," vol. ii., p. 312, and following. The tests for lactic acid, which are, however, not very definite, you will find fully described in Dr. Miller's "Elements of Chemistry," 4th edition, vol. iii., p. 415. Our space will not allow us to transcribe the passages.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 5th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)
—— Medical, 8.
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 6th.—Institute of Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 7th.—Society of Arts, 8.
—— Geological, 8.
—— Pharmaceutical, 8.
THURSDAY, 8th.—London Institution, 7.30. W. Mattieu Williams, F.C.S., "On Count Rumford and his Philosophical Work."
—— Royal, 8.30.
—— Royal Society Club, 6.
FRIDAY, 9th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

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A Subscriber from St. Petersburg.—The second part of the work is not yet published; it will be duly announced.

J. B. Barnes.—Received.

S. E. P.—The letter is too complicated for our pages.

St. Bartholomew's Hospital.—The LECTURESHIP OF CHEMISTRY in the Medical School of this Hospital being vacant, Gentlemen desirous of offering themselves as Candidates are requested to send their Applications and Testimonials to the undersigned on or before Friday, the 9th December next.

WM. HENRY CROSS, Clerk.

St. Bartholomew's Hospital.
November 22, 1870.

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The Session 1870—1871 will commence on the 3rd of October, when the Laboratories will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

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The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

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THE CHEMICAL NEWS.

Vol. XXII. No. 576.

SPECTROSCOPIC NOTES.*

By Prof. C. A. YOUNG, Ph.D.,
Professor of Natural Philosophy and Astronomy in Dartmouth College.

A New Form of Spectroscope.—The instrument, a description of which follows, was designed for attachment to the equatorial of 6·4 inches aperture and 9 feet focal length, belonging to the observatory of Dartmouth College. It is specially intended for observations upon the solar spots and protuberances, and accordingly the principal object kept in view has been to combine a very high degree of power with compactness, lightness, facility of manipulation, and firmness and construction. Having the dispersive power of 13 prisms of heavy flint, each with an angle of 55°, it yet weighs less than 15 pounds, and measures over all 15 inches in length, 8 in breadth, and 4¼ in height. It was made by Alvan Clark and Sons.

The accompanying plate (Fig. 1), taken from a photograph, gives a correct idea of its appearance and general arrangement. The collimator and observing telescope have each an aperture of ⅞ths of an inch, and a focal length of 7 inches, which might advantageously have been increased to 12 inches were it not for the necessity of compactness.

The light from the slit after passing the collimator, is transmitted through the lower portion of a train of six prisms of heavy flint glass, each 2¼ inches high, and having, as stated above, a refracting angle of 55°. A seventh *half-prism* follows, and to the back of this is cemented a right angled prism by which, after two total reflections, the light is sent back through the upper part of the same train of prisms, until it reaches the observing-telescope. This is placed directly above the collimator, and firmly attached to it. Finally, a diagonal eye-piece brings the rays to the eye in a convenient position for observation.

The instrument thus has the dispersive power of thirteen prisms, and even with the low magnifying power of only five on the observing-telescope, shows perfectly the lines of aqueous vapour, which make their appearance between the sodium lines when the sun is near the horizon. Of course, everything shown on the maps of Kirchhoff and Angstrom is readily seen with it, and many lines besides.

Its definition is very beautiful, and the only optical fault of the instrument seems to be a curvature of the lines, resulting from the shortness of the collimator.

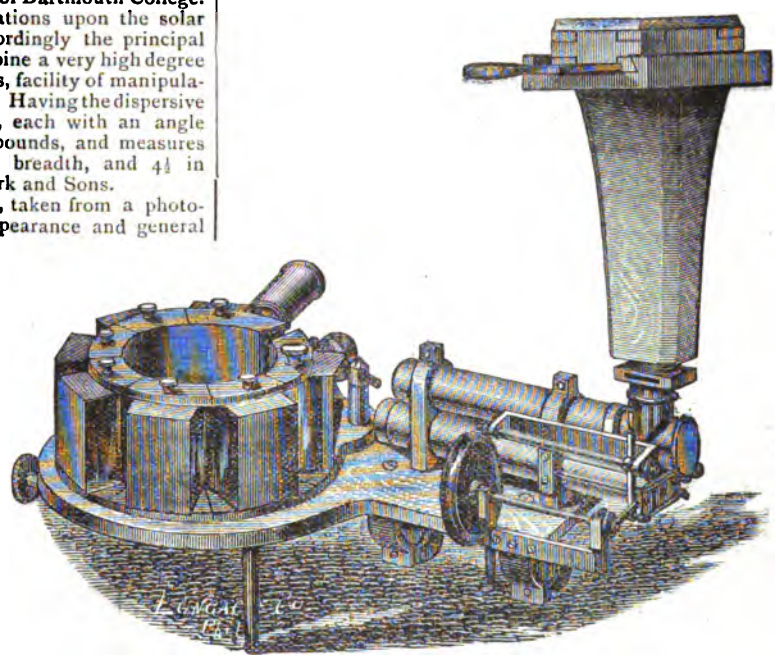
After planning the instrument, I learned that the same idea of sending the light twice through the prisms by a right-angled prism at the end of the train had also occurred to Mr. Lockyer and others; but I do not know that it has yet been put in practice elsewhere.

The prisms, for protection and convenience of handling, are set in frames of blackened brass. They are arranged around the circumference of a hollow cylinder of elastic gun-metal, 3¼ inches in diameter, with stout flanges above and below, between which they are clamped by little thumb-screws, so that they can be readily removed or transposed: it requires less than a minute to put the last prism with its reflector in place of any other of the train, thus reducing the dispersive power to any extent desired.

No particular care is required in placing the prisms, as a couple of narrow flanges were cast upon the cylinder near the top and bottom, and afterwards planed off to form true bearings for the backs of the prisms. They are thus always correctly set by being simply slid home before tightening the clamping screws.

The lower flange of the cylinder is attached to the base-plate by a screw directly under the middle of the front face of the first prism. Around this point as a centre the whole system of prisms is movable by means of a double threaded tangent-screw which brings the different portions of the spectrum into the field of view.

Fig. 1.



The adjustment of the prisms to their angle of minimum deviation is effected by a method devised by Mr. George Clark, which is exceedingly simple, and, if not theoretically exact, answers every practical purpose. The flanges between which the prisms are clamped, are sawed through between the prisms, and a portion of the cylinder, flanges and all, equal to an arc of about 30°, is cut out between the first prism and the last. On closing up or spreading open this gap by means of a suitable tangent-screw, the circumference of the circle around which the prisms stand is correspondingly enlarged or diminished. Probably, when the ends of this opening are drawn very near together, or spread very far apart, the cylinder is somewhat distorted, and a corresponding mal-adjustment of the prisms results; but if so the effect is very slight.

The instrument gives a perfect view of every part of the spectrum A to H: above *h*, however, when all seven prisms are used, there is a loss of light occasioned by a partial obstruction of the apertures of the collimator and telescope by the corner of the reflecting prism.

Were it important to secure the perfect cylindricity of the prism-frame through the whole range of adjustment, it could be easily done by merely fastening at the back of each prism a radial bar acting upon a central pin as in the arrangement first devised by Mr. Rutherfurd, and since adopted by Mr. Browning in his automatic spectroscope.

* From advance-sheets of the *Journal of the Franklin Institute*. Communicated by the Editors.

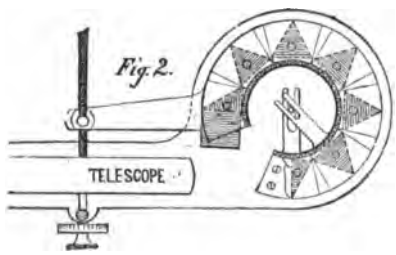
This plan of Mr. Clark's, doing away with all joints and hinges, has the great advantage of perfect firmness and solidity in every position of the instrument, an advantage hardly to be overrated in an astronomical spectroscope.

Had it occurred to me in season I might have made the instrument still simpler, firmer and perfectly automatic in its adjustment, by merely substituting for the first prism a *half prism*,* like the last of the train, to which the right-angled reflecting prism is cemented.

Placing this first *half prism* with its front face perpendicular to the line of collimation it would never need to be disturbed; the flange of the cylindrical frame which carries the prisms would be firmly fastened to the bed-plate immediately beneath it, and the pivot joint at this place with the corresponding tangent-screw would be dispensed with. The only adjustment required would be that produced by the screw which is now used to adjust for minimum deviation by opening or closing the gap of the cylinder.

Of course this arrangement would reduce the dispersive power of the train by the amount of one prism, a loss easily made up by adding a degree or two to their refracting angles.

Fig. 2 exhibits the plan of the proposed arrangement, and requires no explanation, unless to remark that, for



the sake of distinctness, I have represented only two of the radial bars which may be used to render the adjustment accurate.

It might be better to place the face of the first prism not exactly normal to the line of collimation, in order to avoid repeated reflections between it and the object-glass of the collimator, which would be likely to produce a troublesome ghost, or the same thing might be accomplished by simply cementing the object-glasses of both collimator and observing-telescope, directly upon the front of the prism; this would make the instrument still more solid and compact.

The eye-piece of the instrument has an apparatus attached, which, however, thanks to the high dispersive power, I find unnecessary.

It was early proposed by Janssen to use a vibrating or rotating slit in order to make visible the form of a solar prominence, but as Zöllner has shown, the mere opening of the slit answers just as well, the light of the protuberance being diluted to precisely the same extent in either case.

It occurred to me, in connection with a suggestion of Professor Morton, that by interposing at the focus of the eye-piece a diaphragm which should move with the vibrating slit, the light of the neighbouring portions of the spectrum might be cut off and this dilution avoided. Mr. Clark has devised and constructed a very beautiful mechanical arrangement by which this simultaneous and accordant motion of slit and diaphragm is effected by the rotation of the small fly-wheel shown in Fig. 1.

But I find, that although seen in this way, the prominences appear very bright; yet the working of the apparatus always causes a slight oscillation of equatorial, which interferes with the definition of details, and I prefer to work with the slit simply opened. When the air is free from haze, the whole extent of a prominence 30,000 miles in height is readily examined through the C or F line, and the most delicate details reveal themselves, with a beauty and clearness of definition which even yet always surprises me, and speaks most emphatically for the exquisite workmanship of the 43 different surfaces by which the light is either refracted or reflected on its way from the slit of the collimator to the eye.

But, although I do not use the vibration of the slit and diaphragm, I find the mobility of the slit so convenient as to be practically indispensable. In examining the spectrum of a group of sun spots, for instance, it is very much easier to move the slit to the particular point we wish to observe than to move the solar image by the tangent screws of the equatorial.

Photographs of the Solar Protuberances.—The protuberances are so well seen through the F and 2796 (near G) lines, that it is even possible to photograph them, though, perhaps not satisfactorily with so small a telescope as the one at my command. Some experiments I have recently made show that the time of exposure, with ordinary portrait collodion, must be nearly four minutes, in order to produce images of a size which would correspond to a picture of the solar disc about 2 inches in diameter. This length of exposure demands a more perfect clockwork than my instrument possesses, and a more accurate adjustment of the polar axis than it had during the experiments, as well as a steadier condition of the atmosphere.

Thus far, therefore, I have not been able to produce anything which could properly be called a good picture. Negatives have been made which show clearly the presence and general form of protuberances, but the definition of details is unsatisfactory. This amount of success was reached upon September 28th, when impressions were obtained of two protuberances on the S.E. limb of the sun, and, slight as this success was in itself, I consider it of importance in showing the perfect feasibility of going much further with more sensitive chemicals, more delicate adjustments, and greater telescopic power. I was aided in the experiments by Mr. H. O. Bly, our local photographer, to whom are due my warmest acknowledgments for the interest, patience, ingenuity, and skill with which he assisted me.

We worked through the hydrogen γ line (2796 of Kirchhoff's scale), which, though very faint to the eye, was

found to be decidedly superior to F in actinic power The photographic apparatus employed consisted merely of a wooden tube, about 6 inches long, attached at one end to the eye-piece of the spectroscope, and at the other carrying a light frame. In this frame was placed a small plate-holder, containing, for a sensitive-plate, an ordinary microscope slide, 3 inches by 1. The image of the prominence, seen through the open slit, is magnified and thrown upon this plate by the eye-piece. Fig. 1 shows the instrument with this apparatus attached.

It would be easy to improve this arrangement in many respects, and whenever I resume the subject I propose to do so.

As the equatorial, however, has been dismounted, to be put in order for the observation of the December eclipse, further attempts in this direction must be postponed until next spring.

* On returning from the Eclipse Expedition my instrument will be made automatic in accordance with this plan.

Observations of the Solar Protuberances.—Without prolonging this article with the detail of observations, I add a few of the results which have been obtained since September 10th.

About forty different prominences have been more or less carefully observed: sixteen have been sketched. Most of them fall, naturally enough, into the categories established by Zöllner and Lockyer, and are fairly represented by figures already published.

A few deserve especial mention, however. Fig. 3 represents a small one, which was observed upon the E. limb of the sun on September 14th, about 4.30 p.m. From the point marked A, which was very brilliant, a small fragment detached itself and rose towards A', enlarging in size and growing fainter as it rose. It disappeared (from faintness) in about twelve and a half minutes, at a distance of 2' 30" above the limb of the sun, as determined by the time, 8·5", which was occupied by the intervening space in passing over the slit of the spectroscope. Allowing for the

obliquity of the motion to the parallel of declination, the length of path passed over by this cloud was more than 90,000 miles, and the velocity above 120 miles per second.

Fig. 4 represents a prominence observed September 20th, at 4 p.m., on the S.E. limb. (Pos. S., 60° E.) It was a nearly vertical stream, made up of spindle-formed filaments, and had attained the enormous height of 3' 20", or 90,000 miles (determined, as in the case above-mentioned, by a time observation, corrected for inclination). It was very brilliant near the base, and at two or three other points along its length. At 4.30 it was nearly gone, only a few faint wisps of cloud remaining.

Another, observed on September 27th, at 4.10 p.m., and situated on the W. limb of the sun, is represented in Fig. 5. It was formed of separate, well-defined narrow

streamers, which appeared to consist of matter, first violently ejected, and then as violently deflected, by some force acting nearly at right angles. The altitude of the highest point was 1' 25", the length of the whole about 3' 30". I am unable to see how any mere projection from the sun could have produced such a form, and cannot help feeling that it indicates a *something* in which powerful currents may exist, even at such great elevations above the solar surface; in short, an atmosphere extending far beyond the limits which calculation would seem to assign as possible. Is it wholly unlikely that, at such an enormous temperature, the law of Mariotte may fail so completely as to destroy the reliability of any computation that assumes it as one of the data?

Upon the next day the prominence still persisted, but the type was wholly changed: it was replaced by one of the mushroom-formed masses which are so common.

Bright Lines.—In the spectra of different protuberances, the following bright lines have been observed, the numbers referring to Kirchhoff's scale: C; D_1; D_2; D_3; 1474; 1515; b_1; b_2; b_3; b_4; 1990; 2001; 2031; F; 2581·5; 2796; h—17 in all. On one occasion, September 27th, the base of a prominence on the N. W. limb, close to a spot just leaving the limb, exhibited as many as twelve or fifteen short bright lines between E and F, which are not included in the above enumeration, as I had not time to identify them. It is the only instance in which I have seen this phenomenon, more than once described by Mr. Lockyer.

I desire to call special attention to 2581·5, the only one of my list, by the way, which is not given on Mr. Lockyer's. This line, which was conspicuous at the eclipse of 1869, seems to be *always present* in the spectrum of the chromosphere, and shows the form of its upper surface or of a protuberance nearly as well, though of course not so brightly, as the 2796 line. It has no corresponding dark line in the ordinary solar spectrum, and not improbably may be due to the same substance that produces D_3.

The reversal of the sodium and magnesium lines is not at all uncommon. In some instances these lines were so bright, that on opening the slit the form of the prominence could be made out through them. This was the case with a small hand-shaped prominence observed on September 27th. Comparing the form thus seen through D_1 and D_2, with that given by D_3, it appeared that the sodium line was sufficiently developed for observation only along the edge and at one or two bright points in the prominence, most brilliantly neither at its summit nor its base. Fig. 6 represents the appearance

(the slit was perpendicular to the sun's limb). The case was similar with the magnesium lines.

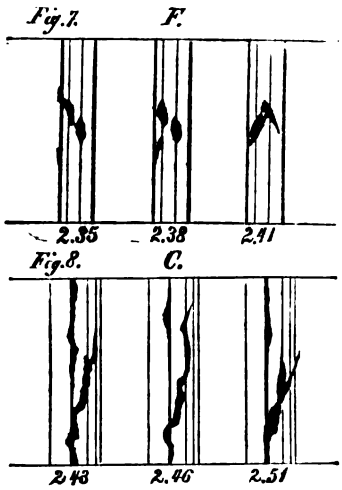
Spectrum of Solar Spots.—Several spots have been carefully examined at different times, most of them, in their spectra, gave evidence of unusual disturbances; but by far the most interesting phenomena were exhibited by a large group which was first observed near the E. limb on September 19th. Changes of wave length were frequent in its neighbourhood.

Figs. 7 and 8 represent the appearances assumed by the F and C lines respectively, at the times indicated below each figure, during an observation on the afternoon of September 22nd. The point where these changes of wave-length occurred was at the western edge of the penumbra. At other times similar changes were observed, but not so great or rapidly varying.

The calcium and titanium lines referred to in my note, published in the July number of the *Journal of the Franklin Institute* (CHEMICAL NEWS, vol. xxii., p. 218), were always conspicuously thickened in the nucleus spectrum.

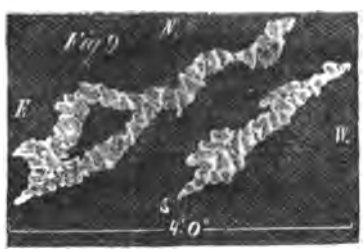
The C and F lines were reversed in some portion or other of the group nearly every time I observed it. On September 22nd, the *sodium* lines were both reversed for several hours, while D_3 appeared as a dark shade. On September 28th, again, at 4 p.m., the southern nucleus of

the group (which at this time contained four large umbræ, besides many small ones), reversed all of the following lines, viz.: C; D_1; D_2; D_3; 1474; b_1; b_2; b_3; b_4; F; 2796; and *h*. All of these were *conspicuous*, except 1474; D_3 and b_3 especially so, and the latter (a nickel

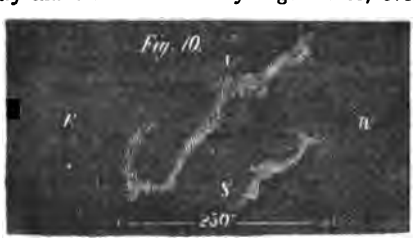


line) showed considerable changes of wave-length, alternate increase and diminution, which were not shared by its magesian neighbours, b_1, b_2, and b_4.

At 4.05 p.m. the brilliance of the F line increased so greatly that it occurred to me to widen the slit, and to my great delight I saw upon the disk of the sun itself a brilliant cloud in all its structure and detail identical with the protuberances around the limb. Indeed, there were two of them, and there was no difficulty in tracing out and delineating their form. Fig. 9 represents them as they



were from 4.05 to 4.10; Fig. 10 gives the form at 4.15-20. They were then considerably fainter than at first. During the intervening ten minutes I examined the other lines of the spectrum, and found that the form could be distinctly made out in all the hydrogen lines, even in *h*;



but that the reversal of the other lines, including D_3, was confined to the region immediately over the spot-nucleus, where the smaller but brighter cloud terminated abruptly; or, I might better say, originated. The larger one faded out at both ends. When the clock-work of the equatorial was stopped, the luminous cloud took 16·7 seconds of time to traverse the slit which was placed parallel to the hour-circle. This indicates a length of at least 130,000 miles without allowing anything for the foreshortening resulting from the nearness of the sun's limb.

By 5 o'clock the clouds had nearly disappeared; a little rack alone remained.

At 4.20 I examined the spot with the equatorial, using the ordinary solar eye-piece. Nothing remarkable was to be seen—not the merest trace of the enormous masses of incandescent gas. It will be interesting to learn whether the earth responded to this magnificent eruption on the sun by any magnetic storm.

I may add that in the telescope this group of spots, from their first appearance, exhibited a strong yellowish tinge, which appeared to overlie all the central portion of the cluster. So conspicuous was it that several persons, unaccustomed to astronomical observation, noticed it at once before I called their attention to it. The penumbra of the group was unusually faint.

Hanover, N.H., October 3rd, 1870.

ON THE

NUCLEAR ACTION OF A SALINE CRYSTAL ON A SUPERSATURATED SOLUTION OF THE SAME SALT.

By CHARLES TOMLINSON, F.R.S.

BEFORE attempting to reply to the second part of Mr. Liversidge's paper (p. 253 *ante*), I must call upon him to get rid of what seems to me to be an illogical distribution of his argument, which I now proceed to expose.

I state that cold supersaturated solutions of *magnesic sulphate* were kept for some time over sulphuric acid in an exhausted receiver, when crystalline crusts of the normal salt were formed on the surface, and that these, by shaking, fell through the solution without acting as nuclei.

Mr. Liversidge replies to this statement by quoting one of Löwel's experiments on *sodic sulphate*, accompanied by Löwel's remark that "it is not the normal salt which is formed in allowing a supersaturated solution to evaporate spontaneously under cover, but the modified salt or that with seven atoms of water."

Mr. Liversidge remarks that such crystals are inactive, "which inactivity seems to be only explicable by accepting Löwel's analyses."

Now, granting for the moment, the relevancy of Löwel's experiment, I want to have it made clear to my understanding, that because sodic sulphate behaves in a certain manner, under certain conditions, magnesic sulphate must also behave in the same manner, under the same conditions.

I have no opportunity of consulting the reference to Löwel's first memoir without going into town, but my impression is that Löwel's experiment was not made for the purpose of determining the nuclear action of the modified sodic sulphate salt, but expressly for determining its hydration. All through this first memoir he accepts Faraday's analysis, and calls it the 8-atom salt; but in a *Note additionelle* he describes an experiment in which a boiling solution of sodic sulphate was placed, in company with calcic chloride, under the receiver of an air-pump, and kept there for days, and, if I mistake not, for weeks, until the whole of the liquid part had evaporated. Then from the lower part of the mixed crystalline mass he selected crystals from which he determined the hydration of the modified salt.

It will be seen from this statement, supposing it to be correct, that Löwel's experiment leads to a very different result compared with that in which crystalline crusts are formed on the surface of a long column of a supersaturated solution.

When a supersaturated solution of sodic sulphate is set aside and left undisturbed for weeks and months the liquid portion diminishes slightly in volume and crystalline crusts are formed in the neck of the flask just above the solution. This effect is best obtained by using a globular flask with a long, straight, cylindrical neck, a portion of which is occupied by the solution. On inclining the flask the solution may be made to wash over these crystals, and even to wash them down, when, in the latter case, they fall slowly through the solution, but in no case do they act as nuclei. I showed an experiment of this kind to a distinguished Fellow of the Chemical Society a few weeks ago. The flask had been kept on a window-ledge during some months: on inclining it the crystals in the neck were washed down, and they fell to the bottom of the solution without any nuclear action. On taking out the cotton-wool crystallisation of the normal salt immediately set in from the surface.

Solutions of magnesic sulphate are well adapted to the exhibition of this class of phenomena, as the crystals not only creep up the neck, but form on the surface, and both results are produced much more quickly than in the case of sodic sulphate.

Ammonium-phosphate also forms clear crystalline crusts in the neck of vessels containing supersaturated solutions of that salt. I have kept the solution in contact with the crust for days together without any perceptible kind of action. In order to see whether the crust was corroded by contact with the solution, I traced an outline of the crust in ink on the outside of the tube before bringing the solution into contact with the crust. After several days' contact I could not find any diminution in the magnitude of the crust or in the sharpness of its outline. Of course the solution, being supersaturated, could exert no solvent action on a salt of its own kind, just as in washing out the remaining colouring matter from a cone of refined sugar a saturated solution of white sugar is passed through the mould; it washes the sugar without dissolving it.

Now, in order to reduce the subject of this note to a practical issue, I have to propose two questions to the gentlemen who have opposed my views (whom, I beg to say, I regard not as opponents, but as friends and coadjutors in the pursuit of truth).

I. Are not the crystalline crusts that form in the neck of a vessel containing a supersaturated solution of sodic sulphate constituted like the normal salt with ten atoms of water?

II. Are not the crusts that form on the surface of long columns of a supersaturated solution of magnesic sulphate and creep up the neck of the vessel constituted like the normal salt, with seven atoms of water?

Unless these questions can be clearly and distinctly answered in the negative on the indisputable grounds of experiment and analysis, then I contend that the general proposition that the best nucleus that can be employed for bringing about the crystallisation of a supersaturated saline solution is a crystal of its own kind, is not true.

Highgate, N., December 5th, 1870.

On page 265, col. 2, line 29 from bottom, for "the surface-tension of the solution was *lowered*," read *increased*.

ON THE

COMPARATIVE INFLUENCE OF VARIOUS SUBSTANCES IN PREVENTING THE DECOMPOSITION OF ORGANIC SUBSTANCES.

By Dr. F. CRACE CALVERT, F.R.S.

On reading the interesting article by Dr. Sansom, in your issues of the 18th and 25th ult., on "Evidence Concerning the Germ Theory of Fermentation afforded by the Action of Certain Substances when Suspended in the Air," it occurred to me that it might prove of some service to many of your readers if I were to lay before them the results of a series of experiments I made some eighteen months ago, to ascertain the comparative powers of various substances ordinarily used as antiseptics.

Before entering into the details of the experiments, I would remark that there is a considerable confusion in the use of the terms antiseptic, disinfectant, and deodoriser, against which it is well to guard. A deodoriser is a substance which removes unpleasant or noxious odours; a disinfectant one which prevents the spread of infection; and an antiseptic one which prevents the substance with which it is in contact from entering into a state of fermentation or putrefaction. As examples of deodorisers may be mentioned chloride of manganese and sulphate of the protoxide of iron. Among antiseptics are chloride of mercury, chloride of zinc, chloride of sodium, arsenious acid, some of the essential oils, carbolic acid, and cresylic acid. Disinfectants are of two classes—those which act by oxidation, destroying the organic substances which give rise to the infection (such are permanganate of potash, bleaching powder, and nitric acid); and those which act, as Dr. Sansom shows, by their presence, undergoing no decomposition themselves, but appearing to poison or render innocuous the germs of disease. To this class belong camphor, and sulphurous and carbolic acids. Of course all the substances above mentioned do not possess exclusively the properties of the class to which I have referred them, but I believe that their predominant characteristic is that which I have assigned them.

With a view of carrying out the statement made in the first paragraph, I made two distinct series of experiments; the first consisted in placing in bottles (not corked) solutions of albumen and flour paste. To these I added various proportions of some of the substances patronised at the present time as antiseptics, and the following table shows the results obtained:—

Antiseptic employed.	Percentage of antiseptic.	Time in which it acquired an offensive odour. Temperature from 70° to 80° F.	
		Albumen.	Flour-paste.
McDougall's disinfecting powder ..	5	11 days	25 days
Carbolic disinfecting powder..	5	Remained sound	Remained sound
Chloralum (made lately)..	2	9 days	—
Chloride of zinc ..	2	15 days	—
Chloride of lime ..	5	16 days	14 days
Permanganate of potash	5	—	—
Tar oil	2	11 days	25 days
Carbolic acid ..	2	Remained sound	Remained sound
Cresylic acid ..	2	Remained sound	Remained sound
None	—	5 days	7 days

The above table clearly shows that the only true antiseptics are carbolic and cresylic acids, and these results coincide with those obtained by Mr. William Crookes, F.R.S., Dr. Angus Smith, F.R.S., and Dr. Sansom. For these two acids continued their action till the albumen solution and paste dried up.

It follows that if deodorisers are merely required for removing the noxious odour from any mass of matter in a state of decay or decomposition they may be used with advantage; such are chloride of manganese, chloride of lime, sulphate of iron, permanganate of potash, chloralum. But if it is desirable to prevent the decomposition of organic matter (and, in my opinion, this is the point to be aimed at, for prevention is better than cure), then carbolic and cresylic acids are the only two substances which attained this object.

As the products given off from decaying organic matter are well known to facilitate the decomposition of similar classes of substances to themselves, if placed in close

proximity (no doubt by the atmosphere conveying the germs), I made the following experiments with the view of ascertaining which of the undermentioned substances would possess the most active power in destroying such germs, and thus preserving the animal substance from decay. At the bottom of wide-mouthed pint bottles I placed a known quantity of each of the antiseptics, and suspended over them by a thread a piece of sound meat, and, by daily examination, it was easily ascertained when the meat became tainted or putrid. The following table gives the results obtained:—

Antiseptic used.	Became tainted.	Putrid.
Permanganate of potash	2 days	4 days
Chloralum	2 ,,	10 ,,
McDougall's disinfecting powder	12 ,,	19 ,,
Chloride of lime	14 ,,	21 ,,
Tar oil	16 ,,	25 ,,
Chloride of zinc	19 ,,	—
Carbolic disinfecting powder	Did not become tainted, but dried up and became quite hard.	
Carbolic acid		
Cresylic acid		

ABSTRACT OF A PAPER ON THE

ABSORPTION OF SULPHUR BY GOLD, AND ITS EFFECTS IN RETARDING AMALGAMATION.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

The author of this paper, while recently investigating the causes of the reported loss of gold during the process of extraction at the Thames Gold Fields, observed that much of this loss could scarcely be referred to any of those causes generally supposed operative for it. He therefore tested the actual condition of the natural surfaces of numerous specimens of Thames gold, in respect to their behaviour with mercury, and examined, further than has hitherto been done, into its comportment with several of those substances likely to be associated with it in a natural way.

The results of these examinations have been minutely recorded in this paper, while the following is a short abstract of them:—

The author finds—

(1.) That numerous samples of bright, clean-looking gold, of all degrees of fineness, refuse to amalgamate on any part of their natural surfaces, though taken directly from the reef and untouched by hand.

(2.) That on such surfaces sulphur is always present.

(3.) That native gold, or gold in a pure state, readily absorbs sulphur from moist sulphuretted hydrogen or sulphide of ammonium, and absorbs it directly when administered in boiling water.

(4.) That surfaces so treated refuse to amalgamate, though no apparent change can be observed in their aspect.

(5.) That gold so affected is rendered amalgamable by wasting in an open fire, except copper is present to the extent of seven per cent (or perhaps less), while the same effect is produced by the contact of cyanide of potassium, chromic and nitric acid, and chloride of lime acidified.

(6.) That this absorption is altogether of a chemical nature.

(7.) That sulphates of iron in presence of air and water decomposed various metallic sulphides common to auriferous reefs, in such a manner as to liberate sulphuretted hydrogen.

The action of sulphuretted hydrogen upon gold, in rendering it non-amalgamable when placed in contact with mercury, was demonstrated with striking effect by the author before the members of this Society.

* Read before the Wellington Philosophical Institute, September 17th, 1870.

From these results the author has been led to suppose that a large area of the natural surfaces of native gold is covered with a thin film of an auriferous sulphide, and that the greater part of the gold which escapes amalgamation at the battery is represented by that portion of this sulphurised gold which has remained unabraded during the processes of milling or extraction from the reef; the state of the gold, rather than that of the mercury, therefore, being the greatest impediment to thorough amalgamation.

In addition to these results, the author communicated others, relative to the effect of solutions of sulphuretted hydrogen and sulphide of ammonium upon platinum. In rendering it non-amalgamable, he believed a sulphide of the metal had formed in each case, since chromic acid rendered it again amalgamable. He also stated that this metal is also so affected by ammonia or the fixed alkalies that it will not amalgamate, except in presence of a mineral acid; from which he suspects platina is capable of superficial oxidisement when in contact with alkaline substances, even at common temperatures.

The author found that his samples of gold were not affected by the alkalies in this manner, except in the case of one from Victoria, a singularity from which was argued the presence of palladium in this particular sample.

ON LIQUIDS OF HIGH DISPERSIVE POWER.

By WOLCOTT GIBBS, M.D.,
Rumford Professor in Harvard University.

Of the liquids which have hitherto been proposed for the construction of prisms, bisulphide of carbon unquestionably presents the greatest advantages. It is cheap, colourless, and unites a moderately high mean refractive to a very high dispersive power. By tacit consent, a prism of 60° filled with this liquid has come to be adopted as a sort of standard. The disadvantages of the bisulphide are equally well known, and I have spent no little time and labour in the endeavour to find a liquid with a still higher dispersive power, less volatile, less sensitive optically to changes of temperature, and less offensive in odour. In these efforts I have not been altogether successful, no one liquid examined possessing all the qualities desired. Many organic liquids with high dispersive powers are difficult to prepare in a state of purity, and speedily become discoloured by absorption of oxygen from the air. Such are oil of cassia, the colourless oil obtainable from balsam of Peru and others. The thallic alcohol of Lamy* is far too costly. The solution of silico-tungstate of sodium†, of meta-tungstate of sodium‡, and of soluble tungstic acid§ as obtained by dialysis, all promised good results from their extraordinary densities, but all proved difficult to prepare in a state of purity, and extremely easy of decomposition.

A solution of phosphorus in bisulphide of carbon, has, according to Messrs. Dale and Gladstone‖, a dispersion of 0·225¶, or nearly one and a half times as great as bisulphide of carbon alone, but becomes turbid on exposure to sunlight from the formation of amorphous phosphorus. It occurred to me that, by dissolving sulphur with the phosphorus, the formation of amorphous phosphorus might be prevented, and experiment proved that this was the case. The solution, as thus obtained, has a pale yellow colour, but is perfectly clear, and undergoes no change by the action of light even when long continued. I have been in the habit of preparing it by dissolving 1 part of dry flowers of sulphur and 2 parts of phosphorus in 4 or 5 parts of bisulphide of carbon, and filtering the

* *Ann. de Chim. et de Phys.*, 4th series, vol. iii., p. 373.
† *Ann. de Chim. et de Phys.*, 4th series, vol. iii., p. 5.
‡ Shiebler, in *Journ. für Prakt. Chim.*, vol. lxxxiii., p. 273.
§ Graham, in *Journ. Chem. Soc.*, vol. ii., p. 318.
‖ *L. and E. Phil. Mag.*, vol. xviii., p. 30.
¶ The number 0·225 is the difference between the indices for the extreme red and violet rays.

liquid through a well-dried ribbed paper filter, which is easily done. The refractive and dispersive power of the solution will, of course, vary with the quantity of phosphorus and sulphur dissolved. By a gentle heat, the whole, or nearly the whole, of the bisulphide of carbon may be driven off, a liquid compound of sulphur and phosphorus remaining, which has so high a mean refractive power that it cannot be employed with prisms having a refractive angle of more than 45°—50°. The same end may, however, also be attained by continually adding phosphorus to a saturated solution of sulphur in bisulphide of carbon, in which phosphorus appears to be soluble without limit.

With a strong and probably saturated solution of sulphur in CS_2, the angle between Li and D was 0° 50′ 10″. When phosphorus was added, the angle was 2° 25′ 30″, the refracting angle of the prism being 60°. In this last case the angle between Na_1 and Na_2 was 0° 2′ 20″. The spectrum was perfectly clear, the definition of the dark lines leaving nothing to be desired. In consequence, however, of the yellow colour of the liquid there is always a marked absorption of the violet end of the spectrum.

In working with the above-described solution, I have employed hollow glass prisms with refracting plates cemented on with a mixture of glue and molasses. These were found to be perfectly tight, and to last for months without change. The great disadvantage in the use of a solution of sulphur and phosphorus consists in the danger of breaking the prisms; the liquid taking fire spontaneously when it has been a few seconds in contact with any porous material like wood or paper. On the other hand, however, the large quantity of sulphur present prevents the fire from spreading, a drop placed upon a piece of wood leaving, after combustion, only a charred spot. When not in use the prisms should be kept in an iron pot with a tight cover. In this manner I have employed and preserved two during a long and hot summer. The viscid, or rather oily, nature of the solution serves to prevent, to a great extent, the formation of ascending and descending currents from slight changes of temperature; and, when the prisms are well shaken before use, the definition remains perfect for a long time. In my spectroscope, the prisms rest upon a plate of glass instead of upon one of metal.—*American Journal of Science.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 1st, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—H. E. Armstrong, Ph.D.; R. Barklie; W. L. Carpenter; T. M. Crafts, Professor of Chemistry in Cornell University; J. Dewas; T. Farries; R. Mallet, F.R.S., and Dr. Ogg.

Mr. PERKIN, F.R.S., read a paper "*On Some Derivatives of Anthracene.*" This was a detailed account of some anthracene derivatives, more particularly of the products resulting from the action of sulphuric acid upon dibrom- and dichloranthracene.

Dichloranthracene.—It is most conveniently prepared by passing chlorine gas over benzol, holding about one-fifth its weight of purified commercial anthracene in suspension, until the mixture becomes a crystalline mass. The product is then brought on a linen filter, drained, washed with cold benzol, dried, and then further purified by distillation and subsequent re-crystallisation from benzol. Thus obtained it appears in golden-yellow needles. The mean of several analyses gave 67·91 per cent C, 3·34 per cent H, and 28·70 per cent Cl, which numbers agree perfectly with the formula of Græbe and Liebermann, $C_{14}H_8Cl_2$.

Dichloranthracene, when gently heated, sublimes in beautiful needles, which may be obtained of considerable size. It is fluorescent in the solid state as well as when in solution.

When a boiling solution of dichloranthracene in benzol is added to a similar solution of picric acid, the mixture assumes a dark orange-red colour, and on cooling becomes filled with small bright red needles. These consist of a compound of dichloranthracene and picric acid. A determination of the dichloranthracene in this body gave numbers closely approximating to those required by the formula—

$$C_{14}H_8Cl_2,C_6H_3(NO_2)_3O.$$

Dibromanthracene.—This product was prepared by Græbe's process. It was, however, purified first by distillation and then by crystallisation from benzol. Thus obtained it is of a golden-yellow colour. It gave on analysis numbers closely agreeing with those required by the formula—

$$C_{14}H_8Br_2.$$

Like dichloranthracene this body produces a beautiful red compound with picric acid.

Action of Sulphuric Acid on Dichloranthracene.—Dichloranthracene, when submitted to the action of fuming sulphuric acid, dissolves, forming a bright green solution, and is at the same time converted into a sulpho-acid.

To prepare this acid, one part of dichloranthracene is added to about five parts of fuming sulphuric acid, and the mixture heated for a short time on the water-bath. It is then gradually poured into several times its bulk of water and treated with carbonate of barium until all the sulphuric acid is neutralised. The acid solution when filtered off from the sulphate of barium is evaporated to a small bulk. When sufficiently concentrated, it becomes, on cooling, a shiny mass of minute orange-yellow coloured crystals, which may be drained on a porous tile.

This acid has not been analysed, but from the composition of its salts evidently possesses the formula—

$$C_{14}H_6Cl_2\begin{cases}HSO_3\\HSO_3\end{cases}$$

Mr. Perkin therefore proposes to call it disulphodichloranthracenic acid. It is easily soluble in water, from which it is precipitated upon the addition of a little concentrated sulphuric or hydrochloric acid. It possesses a strongly acid taste and character.

The acid forms salt with sodium, barium, calcium, and strontium. The barium salt is remarkable for its insolubility in hydrochloric acid.

Dibromanthracene yields with strong sulphuric acid an analogous disulphodibromanthracenic acid—

$$C_{14}H_6Br_2\begin{cases}HSO_3\\HSO_3.\end{cases}$$

Its sodium, barium, &c., salts are similar to the salts of disulphodichloranthracenic acid.

Oxidation of Disulphodichlor- and Disulphodibromanthracenic Acid.—These sulpho-acids, when subjected to the influence of oxidising agents, rapidly decompose, exchanging their chlorine or bromine for oxygen, and are thus converted into disulphanthraquinonic acid.

$$\underbrace{C_{14}H_6Cl_2\begin{cases}HSO_3\\HSO_3\end{cases}}_{\text{Disulphodichloranthracenic acid.}} + O_2 = \underbrace{C_{14}H_6(O_4)''\begin{cases}HSO_3\\HSO_3\end{cases}}_{\text{Disulphanthraquinonic acid.}} + ClCl.$$

$$\underbrace{C_{14}H_6Br_2\begin{cases}HSO_3\\HSO_3\end{cases}}_{\text{Disulphodibromanthracenic acid.}} + O_2 = \underbrace{C_{14}H_6(O_2)''\begin{cases}HSO_3\\HSO_3\end{cases}}_{\text{Disulphanthraquinonic acid.}} + BrBr.$$

An analogous result is also obtained by treating them with concentrated sulphuric acid, the following reactions taking place:—

$$C_{14}H_6Cl_2\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+H_2SO_4=$$

$$=C_{14}H_6(O_2)''\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2HCl+SO_2$$

$$C_{14}H_6Br_2\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2H_2SO_4=$$

$$=C_{14}H_6(O_2)''\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+BrBr+2SO_2+2H_2O.$$

Anthracene, when pure in large crystals, shows a beautiful fluorescence, and so do many of the anthracene products, though curiously their solutions are comparatively poor in this respect. Anthracene and dichloranthracene in the state of vapour are not at all fluorescent, and, moreover, a ray of light sent through the length of about four inches of the vapour of either body still retained its power of rendering fluorescent bodies luminous.

The experiments in this direction are, however, not yet concluded. On sealing up anthracene in a long vacuum-tube with platinum poles, and allowing the discharge from an induction coil to pass through the tube, nothing particular is observed except the beautiful fluorescence of the crystals of anthracene. On examination with the spectroscope, the light showed carbon and nitrogen lines, the latter arising from the presence of a little air in the tube. Upon heating the tube, however, somewhat strongly, so as to volatilise the hydrocarbon, the ordinary colour of the discharge changed to a magnificent deep azure blue, and what is remarkable is that this blue light, when examined with the spectroscope, is perfectly continuous, and consists of blue with a little green.

Dichloranthracene, when treated in a similar manner gives an analogous result, but suffers a good deal of decomposition, anthracene changing but little. These curious results do not appear to be due to the fluorescent character of the substances employed, as naphthaline produces a similar effect, the blue light, though not so intense, being continuous. It must be observed, however, that this hydrocarbon undergoes considerable change, becoming brown and oily.

Anthracene, heated in a vacuum-tube in the same way, gives a greenish blue light, showing faint carbon bands.

On exposing a solution of disulphodichloranthracenic acid to the light of one of the recent displays of the Aurora Borealis, it was very strongly illuminated, as might be expected. Moonlight, on the other hand, had no perceptible effect upon it, nor yet an alkaline solution of esculine.

Mr. Perkin illustrated his interesting communication by a series of most beautiful experiments.

The society then adjourned to December 15th.

LONDON INSTITUTION.

ON Thursday, the 1st inst., Professor MORRIS, of University College, delivered a lecture "*On Gems and Precious Stones*," in which the science of the mineralogist, chemist, and geologist, was combined with the industrial lore of the miner, lapidary, diamond-cutter, and agate-stainer. Having glanced at the different systems of classification adopted by mineralogists, the lecturer noticed the distinctive physical characters of the substances known as precious stones, calling special attention to the crystalline form, cleavage, hardness, and refractive power of the diamond. He stated that the diamond was the only representative among gems of the elementary bodies. It was a form of carbon, and, under certain conditions, it could be readily burned into carbonic acid gas. A curious calculation showed that the great Koh-i-noor if burned would furnish just enough gas to charge from twelve to fourteen bottles of soda-water. The optical properties of the diamond had led Newton to regard it as a combustible body long before the actual combustion of the gem had been effected. The dull varieties of the diamond known as "carbonado" and "boort" were largely used in the arts, for steel-engraving, glass-cutting, rock-boring, and other purposes. The mineralogical and geological features of the diamond beds of India, Brazil, Borneo, South Australia, and South Africa were described, and the frequent association of diamonds with itacolumite, gold, and rutile was referred to as a subject worthy of careful investigation. Other precious stones, such as the sapphire, ruby, emerald, beryl, topaz, jargon, garnet, spinel, and turquoise, were treated of successively, reference being made to their chemical composition, their physical properties, and their application to decorative and industrial purposes. Artificial gems, "doubles" made of glass, faced with slices of the real stones, and artificially coloured agates were noticed, and the characters by which they might be distinguished were plainly indicated. The lecture was illustrated by a valuable and interesting collection of objects. Messrs. Blogg and Martin contributed a unique series of uncut diamonds, exhibiting perfect crystalline forms, some large diamonds from South Africa, and one remarkable specimen embedded in the "cascallio" from a diamond bed in Brazil. Professor Tennant contributed a large collection of diamonds in the natural state, and also some curious specimens of quartz that had been mistaken for diamonds. Through the kindness of Messrs. Hunt and Roskell, the lecturer was enabled to exhibit a fine series of gems and models of the great South-African diamond before and after cutting. To Mr. James Gregory, again, the lecturer was indebted for a collection of ornamental minerals, models of most of the famous diamonds, and specimens of the gravel and rocks associated with the diamonds in South Africa.

On Monday afternoon Dr. ODLING delivered his sixth lecture "*On Chemical Action.*" The circumstances modifying combustion were discussed and illustrated by a remarkable series of experiments with the oxyhydrogen blowpipe, and the hot and cold blast.

NOTICES OF BOOKS.

Die Spectralanalyse in ihrer Anwendung auf die Stoffe der Erde und die Natur der Himmelskörper. Gemeinfasslich dargestellt, von Dr. H. SCHELLEN, Director der Realschule I. O., zu Cöln. Braunschweig: Druck und Verlag von George Westermann, 1870.

The Spectrum Analysis, in its Application to the Matter of the Earth, and to the Elucidation of the Nature of the Heavenly Bodies. A popular treatise, by Dr. H. SCHELLEN, Director of the Realschule I. O., in Cologne. Published by George Westermann, Brunswick, 1870.

THIS is, undoubtedly, the most thorough work on the subject of spectrum analysis which has yet appeared.

Some fifty pages are, in the first place, devoted to the sources of light—such as the oxyhydrogen, the magnesium, and various sorts of electric lights, as well as the common flames and Bunsen burners.

The nature of light, as illustrated by the more readily studied phenomena of sound, and the general laws of reflection, refraction, and dispersion, are then discussed in some fifty more pages.

The spectroscope is then fully described and illustrated with the phenomena of optical phosphorescence and selective absorption. This portion of the work occupies some seventy pages, and is full of new valuable matter, some of which we shall presently describe more in detail.

Next to this comes the sun spectrum and the Fraunhofer lines, with the discoveries of Bunsen and Kirchhoff, and the observations of Janssen and others as to the aqueous lines. A full discussion of the phenomena of sun spots then follows, profusely illustrated with many new engravings admirably executed. This takes us about fifty pages further.

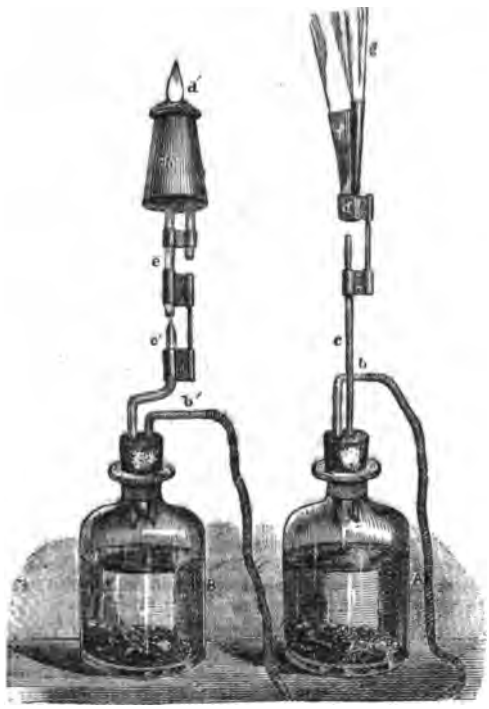
The solar prominences next receive attention, and here we have a full account of the observations of De la Rue

in 1860, with copies of his photograph, and of all the similar work accomplished in 1868 by Vogel, Tennant, Janssen, and others, as also the discoveries of Lockyer and Huggins. Here, also, are a vast number of the most interesting illustrations, and nearly one-hundred pages are devoted to this subject.

The next hundred pages are devoted to a full description of instruments, methods, and results, in connection with the study of stellar, nebular, cometary, and meteoric spectra; and, lastly, we find a few pages on the spectra of lightning and the aurora.

The entire work is eminently characterised by that thoroughness which is the eminent merit of German treatises, and nothing is alluded to which is not fully explained.

Thus we were disappointed to find in Roscoe's otherwise excellent book on this same subject a figure of Bunsen's apparatus for illustrating selective absorption, which was neither self-explanatory nor accompanied by



any description. Here, however, we find a much clearer figure supplemented with a full account, from which the action of this curious and ingenious arrangement becomes at once manifest.

This is of so much interest that we have reproduced the figure on a smaller scale, and here give it with a sufficient description. A and B are two flasks containing zinc and hydrochloric acid mixed with a solution of salt. The hydrogen evolved is thus filled with a fine spray of salt. Pipes *b* and *b'* lead into these flasks the ordinary illuminating gas, which mingles with the salt-charged hydrogen, and escapes by pipes *c* and *c'*, each of which, by a sort of locomotive exhaust action, carries with it a large amount of air into the pipe above, from which the mixture passes into burners, the first of which, *f*, is of a scoop shape, and makes a strong flame, which is to serve as the background to the other. By adjustment of the relative amounts of hydrocarbon gas and hydrogen, the flame, *g*, is made very intense, while *d* is rendered as cool as possible. By this means the light from *g* is well absorbed in traversing *d*, and this later appears as a black flame when seen against *g* as a background.

Portraits of Bunsen, Kirchhoff, Huggins, and Secchi, in the shape of excellent woodcut plates, are interspersed through the book, which has, besides, two coloured plates and 158 woodcut illustrations, a few of which we have seen before in some of Hachett's publications, but the greater portion are entirely new and of great value.

CORRESPONDENCE.

THE PRESERVATION OF STONE.

To the Editor of the Chemical News.

Sir,—In his last letter to you Mr. Church commences by adducing another argument against the originality of his own proposal, and concludes with the following statement—"The legal questions as to patents which Mr. Spiller raises I do not feel to be within my province to discuss." Perhaps not, but this will have to be done by deputy, as I am advised to dispute the validity of the patent for a "Combined Process," which merely unites your own and my inventions, without any superadded feature of novelty to constitute an independent claim.

During the present year I have upon two occasions applied my superphosphate process, exactly in accordance with the instructions which I gave in the text of a paper "On the Decay of Stone; its Cause and Prevention," read at the Dundee meeting of the British Association, September, 1867, and printed at page 123 of your sixteenth volume. The public should be free to use the mixed mono-calcic and baric phosphates as therein described by me (not patented), and we shall soon know what plea can be raised in support of this recent attempt at monopoly.—I am, &c.,

John Spiller.

London, December 3rd, 1870.

MAGNETIC POWER EVOLVED BY A BATTERY.

To the Editor of the Chemical News.

Sir,—Last week I said that no electro-motor had ever yet been constructed with a thoroughly scientific knowledge of the elements of the question. Let me justify myself by enumerating these elements—the mutual relations of which, to each other, has never yet been thoroughly investigated. Indeed, thoroughly to investigate them would require a lifetime, and could only be done by large co-operation. They are, then,—

1. The kind of battery to be used.—Strange as it may seem, different kinds of batteries have very different magnetic effects in particular combinations, and laws deduced from the use of one battery cannot be applied to another. The reason, no doubt, is that when the intensity of different batteries varies, the effect of the reactions and polarisations produced in them differ very much. For instance, Bunsen's batteries and Daniell's, if used in the same experiments, give totally different laws.
2. The size of the plates in the battery.
3. The number of cells as producing more or less electro-motive power, but with a consumption of zinc varying as the square of the intensity produced.
4. The size of wire.
5. The shape of wire, whether round, flat, or square.
6. The length of wire and number of ranges of spires on coil.
7. The number of derivations of circuit.
8. The form of construction of magnet, whether bar, horse-shoe, with two, three, or more poles, whether what the French call *aimants boiteux*, &c., &c.
9. The weight and number of magnets.
10. The relation of length to diameter of magnets.

11. The size, shape, and mode of application of the soft iron armatures.

12. The length of stroke.

13. The best kind of commutators.

And finally, and above all, the most beneficial adjustment of each of these in reference to the others.

We have an infinite source of force. Can we avail ourselves of it economically? Even the most essential element of the question, namely, how the magnetic force varies in regard to the intensity (i) and length of current (l), has not yet been decided. *Quot homines, tot sententiæ.* The prevailing opinion is that the energy varies as $l^2 \times i^2$. Some say that it varies rather as the simple powers than as the squares of these two quantities. My own opinion, formed from the consideration of numerous experiments, is inclined to the conclusion that the energy to be obtained from a current may be made to vary, according to different circumstances, in proportion to almost any powers of l and i, but that if we secured such conditions as should give a maximum of force, the magnetic energy of a battery would be found to vary (nearly, but not quite, as the square of the power of conveying matter by electrolysis, and of the power exercised by a wire over a magnetic needle, namely) as $l^2 \times i^2$. But whether it varies as $l \times i$ or as $l^2 \times i^2$, or as any other powers of l and i, the conclusion remains the same, that $l \times i$, and consequently any power of $l \times i$, may be increased by skill without assignable limit.—I am, &c.,

H. HIGHTON.

Putney, December 5, 1870.

THE REACTION BETWEEN WATER AND NITROGEN TETROXIDE.

To the Editor of the Chemical News.

SIR,—I do not wish to revive in your columns a rather unimportant discussion which arose at the Chemical Society out of some expressions used by Mr. E. T. Chapman in describing a determination of nitric oxide. But as any reader of the brief report sent to you, and of Mr. Wanklyn's comments, who was not present at the discussion, would suppose me to have called in question some familiar and well-established facts, I shall be obliged if you will insert a few lines of explanation.

First, let me repeat what I stated twice in the course of the discussion, that I do not doubt, and have never doubted, the possibility of converting nitric oxide into hydrogen nitrate by the action of an excess of oxygen and water.

Next, as to the only point on which I ventured to differ from Mr. Chapman, and upon which, as far as I was concerned, the discussion turned. What is the reaction which takes place between water and nitrogen tetroxide? Mr. Chapman's view, for which he claimed the authority of a formidable list of text-books, is that these substances react to form hydrogen nitrate and nitric oxide, according to the equation

$$3N_2O_4 + 2H_2O = 4HNO_3 + N_2O_2.$$

If this representation were correct, the complete conversion of the nitric oxide into hydrogen nitrate would be almost instantaneous, and would be simultaneous with the disappearance upon contact with water of the red fumes formed on mixing this gas with excess of oxygen.

But, in fact, at the ordinary temperature, and in the presence of much water, when the red fumes have disappeared, the liquid contains not hydrogen nitrate only, but a mixture of nitrate and nitrite in equivalent proportions. The equation representing the change is

$$N_2O_4 + H_2O = HNO_3 + HNO_2.$$

Afterwards, by degrees, the hydrogen nitrite is oxidised to nitrate, but so slowly that if, even after some interval, the amount of oxygen that has been absorbed is measured, it is found to be just what is required to form nitrate and nitrite, and less by one-third than the amount required to yield nitrate only.

The rate of the subsequent change depends upon the temperature and concentration of the acid liquid, and probably, also, the nature of the change, since a cold dilute solution may be simply oxidised, as hydrogen sulphite would be oxidised, by the superjacent and dissolved oxygen, while a warmer or more concentrated solution would be partially decomposed with evolution of nitric oxide.

But I see no reason for believing that at any temperature near the ordinary temperature the production of nitrite does not form an integral part of the reaction.—I am, &c.,

A. VERNON HARCOURT.

Christ Church, Oxford,
December 3rd, 1870.

MISCELLANEOUS.

Stone Waterproofing.—At the recommendation of Professor Abel, Chemist to the War Department, the process invented by Messrs. Gay and Co., of Alton, Hants, for waterproofing and preserving stone and other buildings, is, by the order of the Office of Works, to be applied to the decayed stonework of the Houses of Parliament.—*Journal of Society of Arts.*

Precaution to be taken in the use of Phosphorus for the Absorption of Oxygen from Gaseous Mixtures.—Dr. Commaille states that when phosphorus comes in contact with a solution of caustic potassa, even at the ordinary temperature, phosphuretted hydrogen is given off, and if, therefore, phosphorus be employed to absorb oxygen from a gaseous mixture contained in an eudiometer tube or bell-jar, into which previously a solution of caustic potassa had been introduced for the purpose of removing from the said gaseous mixture carbonic acid, the result will be that, if the piece of phosphorus be only wetted by the potassa solution, the quantitative estimation of the bulk of the gaseous mixture will become a failure in consequence of the evolution of phosphuretted hydrogen gas. The author states that a series of experiments made by him prove that the increase in bulk of the gaseous mixture is, even at a low temperature, rather considerable, and at summer temperature, after two or three days, the gaseous mixture, when coming into contact with free air, ignited spontaneously when the piece of phosphorus fastened to platinum wire had dipped for a few millimetres depth into the potassa.

Preparation of Ultramarine Test-Paper.—The great sensitiveness of artificially-made ultramarine for even very weak acids has been turned to account by applying that pigment to prepare a test-paper especially suited for the rapid detection of the presence of free acids in such salts as sulphate of alumina, alum, and other similar compounds. The ultramarine intended for this use should be that known commercially as No. 1; it should first be mixed with some water collected on a filter, and then thoroughly washed with some boiling distilled water, and afterwards incorporated with a mucilage made of 1 part of selected Irish moss, previously washed with cold water, boiled with about 30 parts of distilled water; the pigment thus obtained is uniformly painted over best filtering paper, and, after drying, cut up into strips, as is usual for litmus-paper, and preserved in a glass-stoppered bottle. In order to test the ultramarine, it is necessary to prepare a perfectly neutral alum in the following manner. Alum of commerce, by preference, potash alum, is dissolved in from 8 to 10 times its weight of boiling water, and this solution is poured into twice its bulk of alcohol at 80 per cent. The alum separated after complete cooling is collected, redissolved in boiling water, and the solution again poured into the same quantity of fresh alcohol of the same strength; the alum which separates on cooling is collected on a filter, and, after having been washed with alcohol, dissolved in water; a drop or two of this solu-

tion should not discolour the ultramarine, while its almost instantaneous discolouration should follow on its being touched with a drop or two of very dilute sulphuric acid, 1 part of strong acid to from 50 to 60 parts of distilled water.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, June, 1870.

This number contains the following original papers and memoirs on subjects relating to physico-chemical and collateral sciences:—

Relation Existing between the Hemiedric Crystalline Shape and the Thermo-Electric Properties of Iron Pyrites and Grey Cobalt.—Dr. G. Rose.—This lengthy essay, illustrated by a series of engravings, treats especially on the crystallography of two peculiar kinds of minerals, and on the mode in which the crystalline form affects the thermo-electric properties of these substances. Cobalt glance, or grey cobalt, is a rather rare mineral, found especially in Sweden, and consisting, in 100 parts, of—Sulphur, 20·08; arsenic, 43·46; cobalt, 33·10; iron, 3·23;—total, 99·87.

Reduction of the Annual Curves of Temperature to the Conditions upon which they are Naturally Based.—Prof. Dove.—A meteorological essay.

Contribution to our Knowledge of Meteorites.—C. Rammelsberg.—This very exhaustive memoir contains the following sections:—Analysis of meteorites; separation of nickel from iron; extraction and determination of meteoric iron in such meteorites as are chiefly composed of stony matter; analysis of the silicates; on meteoric iron; on the pallasite from Brahin (Russia); on the chondrites from Poltusk, Richmond, and Iowa. The main result of the author's labours is, that the four chondrites analysed by him only contain two silicates—the mono-silicate, or olivine, and the bisilicate, or broncite.

Further Investigations on Methyl-Aldehyde.—Dr. A. W. Hofmann.—This paper chiefly contains the results of a comparative investigation instituted by the author to ascertain how far the experiments and views held by M. Aimé-Girard (published in *Comptes Rendus*, vol. lxx., p. 623), on the methyl-aldehyde, are correct, and how far these researches agree with those instituted by the author. In this essay, the author chiefly treats on the sulphuretted methyl-aldehyde, and states that the assumption of a tri-molecular constitution for that substance leads to far more simple formulæ than when the constitution of that body is taken to be di-molecular, as has been done by M. Aimé-Girard. There is added to this paper an appendix treating on the—

Sulphaldehyde of the Ethyl Series.—This portion of the paper is devoted to the record of a series of experiments on the vapour density of the sulphaldehyde of ethyl, the formula of which has been usually taken as C_2H_4S. The author, however, finds that the proper formula for this body is $C_6H_{12}S_3$; its vapour density, as compared with hydrogen gas, is 90, and as compared with air, 6·25. The author states that there exists an undoubted analogy between sulphmethyl-aldehyde and the sulphaldehyde of the ethyl series, but there is a great difference between the ethyl-metaldehyde and the metaldehyde of the methyl series. The vapour density of metaldehyde, C_8H_8O, was found to be 22 as compared with hydrogen, and 1·52 as compared with air.

July, 1870.

Aromatic Cyanates.—Dr. A. W. Hofmann.—The author refers briefly to his discovery of the body now named phenyl-cyanate; at the time of its discovery (about twenty years ago) it was called anilocyanic acid. This substance is obtained when the diphenyl-carbamide is heated with phosphoric acid, but this reaction is not suited for its preparation in large quantities. While engaged with his experiments on the essential oils of mustard, the author thought that the decomposition of phenyl-urethan might be turned to account for the preparation of phenyl-cyanate. When phenyl-urethan is treated with methylic, ethylic, or amylic alcohols, there are formed phenyl-urethans of the methyl, ethyl, and amyl series. The phenyl-carbaminic acid ether yields, when heated, although a portion escapes decomposition, alcohol and phenyl-cyanate, $C_9H_{11}NO_2 = C_7H_5NO_2 + C_2H_6O$. When phenyl-urethan is heated with anhydrous phosphoric acid, phenyl-cyanate is obtained in larger quantity. The distillate is a volatile liquid, boiling at 163°; its vapour is irritating to the eyes; sp. gr. at 150°, 1·092; vapour density, as compared with hydrogen, 59·5, as compared with air, 4·13. When a glass rod, moistened with triethyl-phosphine, is immersed into phenyl-cyanate, much heat is evolved, and the entire mass becomes solid, exhibiting beautiful crystals. The author then gives a description of some homologues of phenyl-cyanate, and among these is tolyl-cyanate, a liquid which has a strong refractive power and an irritating smell; it boils at 185°; vapour density, as compared with hydrogen, 66·5, as compared with air, 4·61. The tolyl-cyanate exhibits, with triethyl-phosphine, the same reaction as the phenyl-cyanate. Xylyl-cyanate, obtained from xylyl-urethan, is a liquid boiling at 200°; vapour density, as compared with hydrogen, 73·5, as compared with air, 5·10. Naphthyl-cyanate, obtained from naphthyl-urethan by distillation with anhydrous phosphoric acid, is a heavy colourless liquid, nearly inodorous at the ordinary temperature, and boiling at about 270°; formula—

$$C_{11}H_7NO = \left\{ \begin{matrix} CO \\ C_{10}H_7 \end{matrix} \right\} N.$$

Journal für Gasbeleuchtung, October, 1870.

On Hydrotimetry.—M. Grahn.—This paper contains a detailed description of a method for the quantitative determination, by volumetric analysis, of the mineral substances in water. Titrated solutions of soap, oxalate of ammonia, nitrate of baryta, and nitrate of silver are used. This method of analysis was first proposed by MM. Boutron and Boudet, and has been chiefly employed in France for testing the water supplied by the water companies, for whose use it is especially adapted.

Application of Coke as Fuel for Domestic Purposes, and on the Best Construction of Stoves for Coke.—A. Buhe.—This long paper, which is illustrated with a series of engravings, contains a series of interesting experiments on the combustion of coke; the vitiation of air in rooms by its combustion; the best mode of constructing the stoves, and on the the most convenient size of the fuel. For stoves and kitchen fire-places, the author considers that it would be desirable for gas-works to sell the coke, broken up, by means of properly constructed machinery, into lumps about the size of walnuts.

Water Supply of Paris.—Dr. N. H. Schilling.

New Project of Water Supply for Berlin.—Dr. N. H. Schilling.

Annalen der Chemie und Pharmacie, October, 1870.

The original papers relating to chemistry are the following:—

Constitution of Phloridzine.—H. Schiff.—The author first alludes to the action of dilute acids upon phloridzine, $C_{21}H_{24}O_{10}$, which is thereby split up into glucose and phloretine. This latter substance is, when acted upon by a boiling solution of caustic potassa, split up into phloretinic acid and phloro-glucine. The paper further contains a detailed account of the proper formula for denoting the constitution of phloretine, of which the two following formulæ are given:—

$$C_6H_3\begin{cases}(OH_2)\\O\\CO.OH\end{cases}\qquad\text{or}\qquad H\begin{cases}C_6H_3\begin{cases}OH\\CO\end{cases}\\C_6H_3\begin{cases}O\\(OH)_2\end{cases}\end{cases}$$

To ascertain which of these two formulæ is the most trustworthy, the author instituted a series of experiments for the purpose of testing the mode of combination of phloretine with acetyle, by acting on the former body with chloracetyl or acetic anhydride. He also describes the mode of preparation, properties, and constitutional behaviour of the following bodies:—Diacetyl-phloretine, $C_{12}H_{13}(C_2H_3O)_2O_3 + H_2O$; pentacetyl-phloridzine, $C_{21}H_{19}(C_2H_3O)_5O_{10} + H_2O = C_{31}H_{34}O_{15}$; triacetyl-phloridzine, $C_{21}H_{21}(C_2H_3O)_3O_{10} + H_2O$; acetyl-phloridzine; caramel of phloridzine; acetyl-rufine; phloridzin-anilide; phloretin-anilide; mono-acetyl phloridzin-anilide; triacetyl phloridzin-dianilide; tribenzoyl-phloridzine.

Hydrate of Protoxide of Nickel.—H. Teichmann.—The author has studied the behaviour of the protoxide of nickel with ammonia and with carbonate of ammonia. He first calls attention to a fact, which, he says, is not mentioned in any work on chemistry—viz., that when the protoxide alluded to is precipitated from its saline combination at the boiling-heat of the aqueous solution, the resulting precipitate retains acid which cannot be removed by a continuous washing with water, but the precipitate obtained from nitrate of nickel becomes, after long-continued washing, freed from acid; and if other salts of the protoxide of nickel are employed, the impure precipitated hydrated protoxide is readily purified by dissolving it in ammonia to which a small quantity of a salt of that base has been added.

On Chromate of Protoxide of Nickel, and on the Double Chromate of Protoxide of Nickel and Ammonia.—E. A. Schmidt.—This paper treats chiefly on the labours of MM. Freese, Malaguti, Sarzeau, and others, on the salts just named. The author has made a series of analyses which prove that the formula of chromate of protoxide of nickel is $3NiOCrO_3 + 6H_2O$, and not, as stated by M. Malaguti and others, $4NiOCrO_3 + 6H_2O$; but the salt is only formed as long as the protoxide of nickel is in excess, for, when the chromic acid prevails, a salt of the following composition, $5NiO2CrO_3 + 12H_2O$, is formed. The formula of the double chromate of nickel and ammonia is—

$$NiOCrO_3, 6NH_3 + 4H_2O.$$

Action of Ammonia on α Chloro-Propionic and on β Iodo-Propionic Acid.—W. Heintz.—This essay is divided into the following sections:—Behaviour of ammonia with ethyliden-chlorpropionic acid; behaviour of ammonia with ethyliden-iodpropionic acid; behaviour of alcoholic ammonia with ethyliden-iodpropionic acid; behaviour of aqueous ammonia (liquid ammonia) with ethylen-iodpropionic acid.

Diglycolamide Nitrate of Silver.—W. Heintz.—After first referring to his researches on the combination of diglycolamidic and nitric

acids, the author states that diglycolamide nitrate of silver is analogous in composition to dilactamide nitrate of silver. The former body is a crystalline salt, exhibiting a rhombic shape, insoluble in alcohol and water, and decomposed by heat, leaving metallic silver. Composition, in 100 parts—Carbon, 11·71; hydrogen, 1·46; silver, 52·68; nitrogen, 6·83; oxygen, 27·32. The author also describes the lead and copper salts of diglycolamido-nitric acid.

Double Phosphate of Oxide of Copper and Soda.—J. Weineck.—This paper reviews the labours of Dr. Rammelsberg on some salts of phosphoric acid (published in Poggendorff's *Annalen*, lxviii., p. 383 and following. The author describes at length, the preparation, properties, and percentical composition of a salt which, in 100 parts, consists of—Phosphoric acid, 38·32; oxide of copper, 46·45; soda, 8·84; water, 6·75.

Researches on the Isomerism of the Benzol Series.—(Twelfth paper.)—F. Beilstein and A. Kuhlberg.—This paper treats on the isomeric toluidines, and is divided into the following sections:—Para-toluidine; meta-toluidine; ortho-toluidine.

Analysis of Pyrosmalith.—Dr. F. Wöhler.—Pyrosmalith is, according to the author, a rare mineral, only met with in the iron mines of Nordmarken, Sweden. The author quotes the analysis made of this mineral, in 1815, by Dr. Hissinger, and observes that the quantity of chlorine found by that *savant* is probably too low. The analysis now made by the author gives, for the composition of pyrosmalith, the following result, in 100 parts:—Silica, 36·42; protoxide of iron, 22·91; protoxide of manganese, 22·52; peroxide of iron, 5·10; perchloride of iron, 9·73; water, 3·32. The mineral contains, therefore, oxychloride of iron (14·88 per cent = 6·53 per cent chlorine) combined with a double silicate of the protoxides of iron and manganese. Formula—

$$(Fe_3Cl_8 + Fe_2O_3) + \left\{\begin{matrix}\dot{Fe}_{10}\\ \dot{Mn}_{10}\end{matrix}\right\} \dot{Si}_{20} + 8\dot{H}.$$

Presence of Urea in Bile as a Normal Constituent of that Fluid.—O. Popp.—This paper, chiefly of physiological importance, contains the detailed account of the means of separating urea from bile.

Chromate of Chromic Oxide.—O. Popp.

Some of the Products of Conversion of Phenol.—L. Barth.—This lengthy essay contains an account of the author's experiments on testing the action of fusing caustic potassa upon phenol and the various products resulting therefrom.

Bromo-Phenol-Sulpho Acids.—C. Senhofer.—This monograph is divided into the following sections:—The bromine substitution-products of phenol-para-sulpho acid; the bromine substitution-products from phenol-meta-sulpho acid.

Preliminary Notice on some of the Derivatives Obtainable from Gallic Acid.—O. Rembold.—This notice treats on a body obtained by the author by first causing arsenic acid to act upon gallic acid at 120°, and next acting upon the insoluble body thereby generated with sodium amalgam, which is insoluble in water. The author is engaged with further experiments on this subject.

On Saliretine.—K. Kraut.

Sitzungsberichte der Königlich Bayerischen Akademie der Wissenschaften zu München, vol. ii., No. 2, 1870.

This number contains the following papers and memoirs relating to physico-chemical and collateral sciences:—

Resin contained in the Tampico Jalap.—Dr. Spirgatio.—The author says that, in addition to the well-known and officinal jalap-root, the produce of the *Ipomœa purga* of Dr. Wenderoth, there has been imported of late, from Mexico, a new kind of jalap-root, under the name of Tampico jalap, Mr. D. Hanbury* having described this root as the produce of the *Ipomœa simulans*, belonging to the same natural order as the other plants which produce jalap-roots—viz., *Convolvulaceæ*. The author instituted a series of experiments with the view of comparing the properties of the resins contained in the Tampico (the name of a seaport town and river of Mexico) and ordinary jalap-roots. The Tampico resin he calls tampicine, and the resin contained in the ordinary jalap-root, convolvuline. Tampicine is obtained by first exhausting the Tampico-root with water, and then dissolving the resin by means of alcohol; after evaporation of that fluid, the residue is purified by boiling with water; the resin is re-dissolved in alcohol, and the solution decolourised with charcoal. Tampicine agrees generally with convolvuline, as regards its properties, but it is distinguished from convolvuline by being soluble in ether, a property also possessed by jalapine (the resin met with in the root of the *Ipomœa orizabensis*), which, however, differs in its elementary composition. The alcoholic and ethereal solutions of tampicine exhibit a weak acid reaction to test-paper. Like convolvuline, tampicine is converted, by the action of bases, into an acid soluble in water, the elements of that liquid being thereby taken up. The author calls this acid tampicinic acid. Tampicine also resembles convolvuline in being a glucoside, which, by the action of dilute acids, is split up into sugar and a kind of fatty acid, tampicolic acid. Tampicine is soluble in acetic acid, and even at boiling heat is not split up into sugar and tampicolic acid; water precipitates the tampicine unaltered from its acetic acid solution. It is far more sensitive for heat than convolvuline, and cannot, without decomposition, be kept, even at 100°, for any length of time. The melting-point of tampicine is 130°; the formula, dried over sulphuric acid in vacuum, is $C_{34}H_{56}O_{16}$; while the formula of convolvuline is, according to Dr. Mayer, $C_{31}H_{50}O_{16}$. Tampicinic acid is an amorphous, yellowish coloured, brittle mass, void of odour, and exhibiting a sour, bitterish taste; attracts moisture from the air; is readily soluble in water and alcohol, but not in ether; its aqueous solution is a strongly acid fluid which decomposes alkaline carbonates, but that solution is not precipitated by any saline or metallic solutions, excepting those of acetate of lead and bichloride of mercury, which produce a faint turbidity, while a solution of basic acetate of lead causes a bulky, white, flocculent precipitate. Tampicinic acid, heated upon a piece of platinum foil in contact with air, burns, and leaves no residue. The formula of this acid is $C_{31}H_{50}O_{17}$; it is generated from tampicine by the assimilation of $3H_2O$. Convolvulinic acid is, according to Dr. Mayer, $C_{31}H_{50}O_{16}1\frac{1}{2}H_2O$. Tampicolic acid, when pure, is a snow-white coloured crystalline body, void of smell, of an acrid taste, readily soluble in alcohol, but less so in ether; it melts, when submitted to heat, forming an oily fluid which produces a similar stain on paper to oil; on cooling, it becomes a hard, white-coloured stearic acid like mass. The alcoholic solution of this acid decomposes alkaline carbonates. The salts this acid forms with alkalies (potassa and soda) are soluble in water; its other combinations with bases are insoluble in that liquid. The formula of tampicolic acid is $C_{16}H_{28}O_8$, while the formula of convolvuliolic acid is $C_{13}H_{24}O_8$. The process of the splitting-up of tampicine can be represented by the following formula:—

$$C_{31}H_{54}O_{11} + 7H_2O = C_{16}H_{28}O_8 + 3(C_6H_{12}O_6).$$

The author finally states that, according to his experiments, the medicinal use of tampicine is not to be recommended, its action upon the human organism being less sure, and by no means the same as that of convolvuline.

Researches on the Action of the Electrophor.—W. von Bezold.—The contents of this long and exhaustive memoir may be summarised as follows:—The electricity generated by rubbing the upper surface of the resin-plate of the electrophor exerts a diffusing action upon the lower or bottom resin-plate. If the primary excitation is sufficiently strong, the negative electricity of the lower plate forces its way through the layer of air existing between it and the resin-cake, and thereby causes the production of electric sparks. At the same time, the electricity primarily generated becomes partly fixed to the upper plate; and this process lessens the activity of the electricity of the disc, and also prevents electrical action between the two plates. The negative electricity of the disc, called forth by diffusion, remains in the disc, and can be made active by the removal of the disc. The efficiency of the instrument depends greatly upon the fact, that, when the disc is in position, it is in circumstances highly favourable to intense inductive action.

* *Journal of the Linnæan Society*, vol. xi.

NOTES AND QUERIES.

University of Giessen.—"Vox's" best plan is to go Giessen and follow the legitimate course of studies, and so obtain the degree.

Pyrotechny.—Can any of your readers recommend a thoroughly practical work on pyrotechny in either French or German, if there is not such a one in English? Also, where the apparatus can be had.—Ernest J. Witheford.

Turkey Red.—I shall take it as a favour if any of your readers would kindly tell me how this new Turkey red, from aurine (rosolic acid), is prepared for the use of paper printers. Aurine is changed by alkalies into a crimson, but I wish to know how this crimson is precipitated.—Magenta.

Alkaline Fluorides.—Reply to O.X.O.)—When hydrofluoric acid is saturated with potassa and evaporated to dryness, a deliquescent and difficultly crystallisable compound is obtained, which can be intensely heated without decomposition; its solution acts upon glass. The salt is decomposed by sulphuric acid and also by chlorine, hydrofluoric acid being evolved.

Crith.—The word "crith," proposed by Dr. Hofmann, was a very convenient one to express the weight of a litre of hydrogen, and has been adopted by some chemists. However, most teachers, I believe, now prefer to use Dr. Williamson's standard volume of 11·2 litres in making calculations with gases. I have been cudgelling my brain for some time past to find a euphonious word to express this volume. Will you allow me in the columns of your influential journal to draw the attention of our classical friends to this subject, and to ask them for suggestions?—Teacher.

MEETINGS FOR THE WEEK.

Monday, 12th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)
—— Medical, 8.
—— Royal Geographical, 8.30.
Tuesday, 13th.—Institute of Civil Engineers, 8.
—— Photographic, 8.
—— Ethnological, 8.
Wednesday, 14th.—Society of Arts, 8.
—— Microscopical, 8.
Thursday, 15th.—London Institution, 7.30. W. Mattieu Williams, F.C.S., "On Count Rumford and his Philosophical Work."
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8. W. H. Perkin, F.R.S., "On some New Derivatives of Coumarin."

THE CHEMICAL NEWS.

VOL. XXII. No. 577.

ON THE SEWAGE QUESTION.*

By EDWARD C. C. STANFORD, F.C.S.

I HAVE been requested by the Committee of the Sanitary Section of the Philosophical Society to remind the Section of the origin of its existence; and, after the great variety of excellent papers read in this Section last year, it is, perhaps, as well to remember that we grew out of the Sewage Association of Glasgow, and that the subject which that Association met to discuss is still, even more than it was then, one of the most important, and the most interesting, as it confessedly is also still the most difficult problem of the day.

I have much pleasure in recording our early labours, because they were not without an important result. After a great number of discussions, where every possible variety of opinion was expressed, and where most of us commenced with the usual strong prejudice in favour of sewage by water carriage, we actually did pass *unanimously*, at the close of the session in 1868, the following resolution, first in committee and then in open meeting:—

"That, in the course of the discussions which have taken place at the Association's meetings, sufficient evidence has been produced to warrant them in recommending the authorities, before coming to any conclusion on the subject of the sewage, and purification of the river, to make experiments on the practicability of such schemes as proceed on the principle of providing that fœcal matters must no longer be allowed to enter the common sewers or the river."

Again, I find in the minutes of a meeting in this section on the 28th December, 1869, in the discussion on Dr. Grey's paper advocating a system of water carriage, that—"The Section expressed disapproval of that mode, and affirmed to the finding of the Sewage Association on the subject."

I remind the Section of these resolutions because I consider them real marks of progress, and because they show that we have had the courage to pause, and seek other solutions of the difficulty than that one idea constantly thrust upon us by high engineering authorities, which sounds very like the cry of "Water, water everywhere, but not a drop to drink."

The present year has been marked by the appearance of two authoritative reports—the "Report of the Rivers' Pollution Royal Commission," and the Report of the British Association Committee "On the Treatment and Utilisation of Sewage," which has appeared as a volume by Professor W. N. Corfield. Of the Report of the Royal Commission, I feel bound to say that it is the most valuable and comprehensive which has yet appeared; the innumerable analyses of water and sewage testify to the completeness of the inquiry; and show that Dr. Frankland has taken up the subject with his usual accuracy and breadth of view. The nature of the enquiry, that of the pollution of rivers, has, however, naturally led the Royal Commissioners to look at our town refuse at the large, and, therefore, in my opinion, the wrong end, and to try to stem the tide of contagion after it has become a river, rather than to deal with the pollution at its source. Irrigation, then, as a necessary consequence, will probably be duly enforced as the compulsory result of a compulsory water-closet.

Of the Report of the British Association Committee, I cannot, however, speak so favourably. This committee was appointed in 1868, and a short but valuable statistical report from it was read at Exeter in the following year. It was then re-appointed, with a grant of £50 from the Association, and several new members added. The Committee then took the unprecedented course of applying to cities and towns to contribute to their funds in sums proportioned to the number of inhabitants; they thus raised about £1500, of which I understand about £500 have been expended. Several gentlemen representing towns who had thus subscribed indignantly asked, at Liverpool, what had been done with their money; and Prof. Corfield's book, since published, was their promised solace. The actual report will not appear till the publication of the *Proceedings of the British Association* for 1870, but this work is published under the authority of the Committee, and pretends to be a synopsis of its views. There appears, however, to have been some strong dissension amongst the Committee, for one of their number—in fact, the reporter of the former year—at one of the Liverpool meetings, expressly denied all complicity in the Report of this year. The Committee underwent so severe a handling in two sections where the report was read, that they withdrew it from a third, where it was also to have appeared. My impression certainly is that they would have been more severely handled if Professor Corfield's work had been then published as the principal result of their labours. This work is a *re-chauffée* of the Report of the Royal Commission, in which the facts of the original are not improved on by the *opinions* of the author.

Corporations and town councils who have subscribed to the British Association Committee will, no doubt, be gratified to learn that they can purchase this interesting volume for 7s. 6d., and read in abstract what has been already published *in extenso* in a Government blue-book, well illustrated with plans, maps, and engravings, for 5s. Some who have subscribed largely may not object to a balance-sheet in the next edition.

The Committee were charged at Liverpool with a strong prejudice in favour of water carriage and irrigation; and certainly no one can read this work without seeing at once that its purpose is directly to enunciate these views. One remarkable part of this report, however, is that it advocates the use of a separate system of sewers for house sewage, and of settling or filtering the sewage before employment for irrigation. Now the former is an extraordinary admission for sanitary engineers to make; it shows the correctness of our views, and concedes the real point of our demands. We have always been told that a double set of sewers would entirely upset our existing system, and that it never could be carried out. Amongst others, Dr. Anderson, in his report, states it to be impossible. Having now admitted this necessity, the whole question is reversed, and I maintain that the step is in the right direction; and the next consideration (which ought to have been the first) should be to really carefully examine the best methods of dealing with house refuse. This, I maintain, has never been fully, fairly, and systematically done. In neither of the reports now referred to has sufficient justice been done, or sufficient attention been paid, to any system of removal of excreta, other than by water carriage.

Lieurnur's pneumatic system is not alluded to at all in the Rivers' Pollution Report, and dismissed in a few words without evidence in the other.

The charcoal method of removal, though brought forward at the British Association at Exeter, and before some of the Committee, is alluded to in neither. Nor is the remarkable deterioration of lead pipes, when attached to water-closets, mentioned, although the evidence has never been contradicted. The ingenious method of distillation of sewage proposed by Mr. Chapman is also unnoticed. Mr. Hoey's method of saving water in the ordinary closets is not spoken of. Weare's method of sewage filtration through charcoal and ashes is not referred to. Now these processes may not have come under the notice of the Royal Commission; but I maintain that

* Read before the Glasgow Philosophical Society (Sanitary Section), Nov. 9th, 1870.

tion of a more complex body than aldehyde violet, viz., the green. Unfortunately, the green is, I believe, only formed under conditions wherein silk would be destroyed. A single experiment however, was made with this view.

M. Lucius patented a process some time ago for the preparation of the green in which he takes advantage of the reducing property of H_2S.

Thinking I might succeed in producing the green by heating the rose-dyed silk with solution of H_2S and excess of aldehyde, the experiment was made. The silk, however, was destroyed; the fluid had a green tinge. I hope to return to this matter.

All the above experiments were made with wool, and gave similar results.

Aniline red on cotton, fixed with albumen, is susceptible of conversion into aldehyde violet. Theoretical considerations would scarcely lead one to expect a successful issue in this instance, but would rather imply that insoluble albumen, locking up the colour in the fibre of the cloth, would present a barrier to some extent impassable to cold aqueous solutions. Such does not appear to be the case.

When rose-dyed silk or wool is dipped in a strong solution of aldehyde the change of colour is instantaneous and partakes more of a blue shade; it is very fast to boiling soap. Such a method of using aldehyde violet may be found advantageous in practice and possibly replace other violets more expensive to manufacture.

Chorley, Lancashire.

ON FERMENTATION.*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from p. 269).

LECTURE II.

OUR last lecture ended at a point at which we had come to recognise a difficulty, which we did not, to any appreciable extent, succeed in solving. By considering in succession a certain small number of processes in which substances induced chemical changes in others which were in contact with them, we classified them, beginning with some very complex cases—cases in which substances, of formulæ so long that, even if I ventured to give you chemical formulæ at all, I should hesitate to give you their formulæ—took part in the decomposition, and gave rise to products themselves having formulæ of no small complication. From those we passed to the consideration of some bodies less complex in their structure, and undergoing changes very much like those which we at first considered, but having this remarkable peculiarity that, in these somewhat simpler cases, the changes were effected not only by organic bodies comparable to ferments, but also, in certain instances, by simple mineral bodies, such as the acids. In this intermediate class we found that the same effects are produced, sometimes by diastase, or such like bodies, and sometimes by sulphuric acid. Then we came to some still more simple cases of decomposition, produced solely by bodies of such simplicity that we chemists have got a tolerably definite idea of them. I gave two cases which I believe I may say are pretty well understood. The resemblance between the different terms of that long series served, as I think it will be admitted by those who followed the chain of reasoning, as an argument in favour of there being some great resemblance in the process which takes place in these changes in the successive terms of the series; and I propose, before we proceed further in the study of these wonderful decompositions, to analyse somewhat the nature of these changes in the simple cases which we last considered, in order that we may get, if possible, something like a master-key—a very simply-formed piece of iron—which will open a variety of locks. The two cases which I allude to were, first, the formation of ether and water from alcohol by the action of oil of vitriol; and, secondly, the ordinary process of making oil of vitriol in the so-called lead chambers; and I think it will be admitted, even from the very brief and imperfect statement which I was able to make, that we have evidence of the fact that the active substances do return, after they have been doing one bit of that work, from the point from which they started before doing it. I gave a couple of illustrations of that fact. Sulphuric acid is converted, while making alcohol into ether and water, into a substance called sulpho-vinic acid, which differs from it in a good many properties, and then it comes back again to sulphuric acid. Just so with nitric oxide, in the process of making oil of vitriol; it first takes up oxygen and assumes the form of those red fumes, then hands that oxygen over to the sulphurous acid which is in contact with it, thus coming back again to the state of nitric oxide from which it had started. Hence the term which I have suggested for this process is cyclical, to denote the fact which I consider essential, the leading fact, that it is a cycle, the idea of which implies that the road by which it returns is not the same by which it goes, and I want that idea to be suggested by the word. In the case of etherification, I wish I could lawfully use formulæ on the blackboard, but it would not do, for I am sure that the greater number of my audience will agree with me that it would be a liberty which I ought not to take; but chemists are in the habit of denoting, by the aid of formulæ, particulars which require to be fully explained. I mention that because, excluding that ordinary process, the particulars of my argument must, of course, be omitted, inasmuch as I do not use the language by which alone those particulars can be conveyed. When the sulphuric acid acts upon alcohol, and transforms it, by a succession of these cyclical processes, into ether and water, the general kind of process is this:—A little particle of the acid—because each one acts like the rest, and we had better consider one as a sample of the rest—first takes something from a contiguous particle of alcohol, and then it hands over this something to another particle of alcohol. That which the acid takes in the first instance is called, in our ordinary language, ethyl. It is a group consisting of carbon and hydrogen, very much like hydrogen gas—it is a group of those elements, and behaves in a manner closely analogous to hydrogen itself. The acid, in doing that particular work which we have to consider, first takes a particle of this ethyl from one particle of alcohol, and whilst it does so, it gives to the alcohol something in exchange; that something is hydrogen. And by doing this, the sulphuric acid which has taken up this ethyl is converted into sulpho-vinic acid; it has gone half round the circle, in fact. The remainder of its journey consists in reversing, in another way, with another particle of alcohol, that very same kind of interchange which it had undergone in the first instance, that is, it gives up again this little portion of ethyl which it had taken, and resumes hydrogen in place of it. Just as that is the general process when sulphuric acid acts upon alcohol, forming it into ether and water, so in the other process, which I just now reminded you of, there is a similar action, only there is this difference—of course, I speak within those narrow limitations which are imposed upon us by our very imperfect knowledge of even these best-known processes—but, as far as we know, the nitric oxide merely takes up oxygen, but gives up nothing in exchange. Those red fumes which you saw were really nitric oxide *plus* oxygen, not nitric oxide in which oxygen had replaced something else, and that was a difference between the process in that case, and in the one to which I just now referred. Then, again, it simply gives up that oxygen to the particle of sulphurous acid.

The illustrious Liebig, to whom we owe, in this order of phenomena as in every other order which he has touched, some of the most valuable ideas which have guided our researches, suggested many years ago, for the explanation of the phenomena of fermentation, a theory which certainly has rendered very great service, and not the less so from the fact that it has been replaced

* The Cantor Lectures. Delivered before the Society of Arts.

by one more perfect. In building a house, it is certainly no proof that a scaffolding is unnecessary that in the final structure the scaffolding is not maintained; and so in the progress of our science, as in every other science, each part of the work must be judged from its usefulness in aiding the carrying on of the building, even though the particular substance which was placed there at the time does not finally form part of the structure itself. Liebig's explanation really is classic, and well worthy of a few minutes' consideration. He classed together a considerable number of cases of chemical action which bore, at least upon their surface, a considerable resemblance to one another, and he saw in them something in common, and by this one resemblance which they had he classed them, considering it to be their essential characteristic feature. For example, there is a substance which is made, by a process of oxidation of a compound something like lime. It is called baric peroxide. Thenard had found that the oxygen which is here taken up by the baryta can, by a particular process, be passed over to water, so that, in fact, Thenard, from his oxide of baryta, made by a process which I will repeat on a small scale, some oxidised water or peroxide of hydrogen, as it is commonly called. Here is some of the peroxide suspended in water, and by adding an acid hydrogen salt, the hydric nitrate, in small quantities (for if I add it in too large quantities, I should destroy the peroxide, which is a very tender substance, and requires to be treated tenderly), I should gradually transfer the oxygen from the baryta, with which it was at first combined, to the water which is here present. This oxidised water, or peroxide of hydrogen, gives up this oxygen which it has just taken up very easily indeed—in fact, the difficulty is to prevent it doing so. Amongst processes of that kind, I will show you one simple one. I will pour into the water in this large beaker glass some of the solution which I have just prepared, and then add to it a few drops of this red liquid, which is a solution containing chromic acid combined with potash. You see, no doubt, that although I have only added half-a-dozen drops, there is evidence of a chemical change, and the deep blue colour which is formed by the contact of the two liquids is due to the formation of a new compound. The chromic acid, which has a red colour, takes up oxygen from that peroxide of hydrogen, forming a blue compound. I have purposely chosen this particular instance, because the process is a slow one, and we have time to see its intermediate changes. I will leave the glass here, and in a few minutes you will see the blue colour will have disappeared, and in place of it we shall have a dirty green colour, hardly visible. Whilst that change takes place, if we were to take means to examine carefully what was going on, we should find that oxygen gas passed off, and if we examined the green substance present at the end of the process, and compared it to this original red chromic acid, we should find that it consists of chromic acid *minus* oxygen. The peroxide takes away oxygen from this chromic acid, and yet the chromic acid has got hold of its oxygen pretty firmly; it requires a considerable amount of energy to tear away even that part which is torn away by the process. But at the same time the oxygenated water is losing part of its oxygen. The deoxidation of the peroxide induces the chromic acid to give up some of its oxygen; the one body induces in the other a change similar to that which itself is undergoing. The peroxide of hydrogen is losing oxygen, and it makes the chromic acid also lose oxygen. To state the process in general terms, I may well use the expression of Liebig, and call it contagious action. There are many other cases of similar processes. Here is a bit of rotten wood; if I were to moisten it and put it into a convenient flask, leaving room for a quantity of air, closing the mouth of the flask with a good cork, and leaving it for a day or two, also putting with the air a little hydrogen gas, which, you know probably, is capable of combining with oxygen, I should, on examining the mixture of air and hydrogen after it had been in contact some time with this rotten wood, find that the hydrogen had been removed from the air, and at the same time the oxygen of the air which had been mixed with it had disappeared. Now, this wood is actually undergoing a process of combustion—it is actually absorbing oxygen, or being burnt, very slowly indeed, but still at a rate which is not unimportant, if you want it to last for any length of time. De Saussure, who noticed this, attributed the oxidisation of the hydrogen gas to the fact that the wood is itself undergoing oxidation. I will take another case of the same kind. I will put into a little flask some of that peroxide of hydrogen, and will show you another decomposition of it, which is rather more convenient in one respect than the one I first took, as it will show us something more of the process. Into this little flask I put some of the same oxidised baryta which I used just now, and I will fit up the flask in such a manner that the gas, which will come off in a tolerably large quantity, can be collected for examination. I will then put in contact with it a substance called silver oxide, first driving out of the flask all the air which it at present contains. Having driven out the air, I put in a few drops of the nitrate which I employed in the first instance, and then I will put in a solution of silver oxide, which is, in some respects, a good deal like this chromic acid, at all events in one important respect, for it has oxygen, which it can give up under sufficiently strong pressure. You now see there is a great deal of effervescence going on, and the gas which is coming off from the little flask is rising into this jar, where we shall very easily be able to ascertain whether it is oxygen by the ordinary test. I should have been glad, if it had been convenient to do so, to give you one other instance in which a remarkable fact was discovered by Professor Brodie, viz., a case of an action of this kind, where the oxygen taken from the peroxide is in quantity exactly equal to the quantity of oxygen from the other body. Whilst that gas is collecting, I must enter shortly upon a theoretical question, apologising for doing so, not that I am ashamed of it, for it is one of the most important theories we possess, but on account of the brevity with which I am compelled to treat it. Oxygen, in the free state, is admitted by chemists to consist of two little atoms linked together. In each of the compounds which I used there was one little atom of the kind. One atom leaves each of them, and when I get free oxygen, I affirm that there has been a process of combination, that the oxygen from the one substance actually combined chemically with the oxygen from the other. This is a theoretical result which has been, in great part, established by Sir Benjamin Brodie, with the help of materials from various sources. What I mentioned in the other case holds good equally in regard to chromic acid and the other cases in which there was apparently no definite proportion of the kind. There is an actual chemical combination between the oxygen of one substance and that of the other; it is not merely that the one substance is compelled to decompose because the other is decomposing; there is between the one substance and the other an interchange, so that a constituent from each one combines with a constituent from the other. To do justice to the importance of this fact I should need to describe a great number of chemical reactions, which at present would be impracticable, but you may take my word for it, that the kind of process which I have described is now known to be one of the commonest in chemistry. The other day, when I mixed two of the commonest substances, there were interchanges between the constituents by a process perfectly analogous to that which takes place here. Here it happens, by an exceptional circumstance, that the element which from the one body combines with the element of the other is of a like kind, whereas, as a rule, you find that unlike elements unite together in these processes. Thus it is that the anomaly which Liebig noticed ceases to be an anomaly, and is brought back to a case of common regular chemical action by the aid of that theory to which I have just alluded.

(To be continued).

SCIENTIFIC NOTES FROM AMERICA.

By PROFESSOR LEEDS.

The chemists engaged in the manufacture of phosphates for agricultural purposes will be interested in the extensive use which is being made at the present time of large beds of phosphatic material located upon the Ashley River in South Carolina. It occurs in the form of nodules or pebbles, which are enclosed in a layer of bluish mud, the whole having an average thickness of fifteen inches, and extending in a nearly horizontal layer over an area of many square miles. Although it has long been known, and its very abundant fossils were referred by the geologists of the State Survey to the post-pliocene formation, yet the gravest mistake was made by the farmers of the neighbourhood regarding the chemical nature of these phosphatic nodules. They were regarded as siliceous limestones, and the numerous failures which attended the employment of the product arising from burning them in kilns were attributed to the supposed excess of silex contained in them. The pebbles constitute about 63 per cent of the bed, and the yield of phosphatic material to the acre is about 1200 tons.

The first bar of tin ever made in the United States was recently presented to the Society of Pioneers in California. It contains, by assay, 97·09 per cent metallic tin. On one side is engraved the inscription—"First bar of tin ever produced in the United States from the native ore, taken from the San Jacinto Tin Mine, San Bernado County, California. Presented to the Society of California Engineers, by O. P. Sutton, April, 1870."

A trial was recently made of the so-called United States Chemical Fire Engine, upon a vacant lot situated in the suburbs of New York. Two two-storied buildings were erected and filled with tar barrels. Both of them were drenched with gasoline, in order that the flames might rage with great fury. One of the buildings, on ignition, was played upon with a solution of sodic sulphite in numerous small streams, the other with ordinary water. The trial was not satisfactory, because the framework of the buildings was so slight, that both buildings gave way shortly after the fire commenced, and were converted into a heap of ruins. It is claimed by the inventors of these fire engines, that the sodic sulphite is decomposed in contact with burning surfaces, and that the sulphurous acid gas which is disengaged, while efficacious in extinguishing of flames, is less injurious to the firemen than the carbonic acid gas employed in a rival invention.

A great blow has recently been given to the long cherished hopes of many of our chemists and naturalists. It was proposed that four small public parks, known as the Penn Squares, which are located at the intersection of Broad and Market Streets, the two principal thoroughfares of Philadelphia, should be given to the Academy of Natural Sciences, the American Philosophical Society, the Franklin Institute, and the Academy of Fine Arts. All of these institutions have suffered greatly of late years for want of room and suitable accommodations for their collections of specimens, books, models, and painting. But the people in a general election—an impression having been made that public property to a large amount was about to be given away to private parties for private ends—decided by an overwhelming majority in the negative.

At a recent meeting of the American Philosophical Society it was stated by Dr. Genth that, according to Del Rio, an alloy of gold and rhodium is found in Mexico, which contains from 34 to 43 per cent of the latter metal. This discovery has never been confirmed, and there is perhaps no mineralogist living who has ever seen it. Some experiments which he has lately made with residues from San Domingo gold leave very little doubt as to the existence of this very interesting substance. Professor Gabb sent a lot of gold from San Domingo to Dr. Horn, who dissolved out the gold by *aqua regia*, and placed the remainder in Dr. Genth's hands for examination. He found that it consisted of iridosmine, of a dull yellowish substance in microscopic rounded and angular grains, and a silicate which, under the microscope, appeared to be topaz. One of the yellowish grains acquired metallic lustre when flattened out in an agate mortar. It was almost insoluble in *aqua regia*, but by treating it for several days with a large excess of this solvent, it was finally brought into solution. A trace of ammonic chloride was added, and the whole evaporated to dryness and sufficiently heated to reduce the gold. Mixed with this were microscopic reddish crystals, which were dissolved in boiling water, filtered, the filtrate evaporated to dryness, and the residue slightly heated, by which it assumed a reddish brown colour. On being fused with potassic bisulphate it gave a slightly rose-coloured mass, soluble in water, aud precipitated yellow by ammonia. From these reactions there seems to be no doubt that the yellowish grains are rhodium gold.

At a subsequent meeting, Dr. Genth exhibited photographs of a new meteoric iron, weighing about twenty pounds, which was found on a small mount in Rockingham Co., N. Carolina. The iron is coated with a crust of hydrated sesquioxide of iron. A polished portion of it, after etching with dilute nitric acid, developed the Widmannstædtean figures, and showed a very remarkable structure of the iron. It is composed of three different kinds of iron—one portion of it is quite homogeneous, and has a very fine granular structure; if, however, the light is reflected in different directions it shows a peculiar glistening, and, very faintly, lines intersecting at angles of about 60° and 120°; this same iron runs into bands of not over 0·5 m.m. diameter, which, at another portion of the iron, intersect at angles of about 60°. The space between the bands is filled with an iron presenting a reticulated structure. Disseminated through the iron are crystals of rhabdite, but few only show a regular arrangement. A preliminary analysis gave—

	Per cent.	
Iron	90·41	
Nickel (cobalt)	8·74	
Copper	0·11	
Iron	0·27	Phosphide insoluble in chlorhydric acid.
Nickel (cobalt)	0·33	
Phosphorus	0·14	

Traces of a quartz mineral.

Dr. Genth also exhibited specimens of native iron and native lead from the bed-rock of gold-placers, at Camp Creek, Montana Territory.

The native iron is found in small angular fragments, but slightly coated with rust; the largest which he has seen is about 0·5 inch in length. Etching with dilute nitric acid does not develop any Widmannstædtean figures, but a finely granular structure. Nickel and cobalt are not present. Associated with the iron is native lead, in irregularly shaped rounded and flattened pieces, from the size of a pin's head to about 0·5 inch in diameter.

Philadelphia, Nov. 2, 1870.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 29th, 1870.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

"*The Tails of Comets, the Solar Corona, and the Aurora considered as Electric Phenomena*," by Professor Osborne Reynolds, M.A.

Although the tails of comets are usually assumed to be material appendages which accompany these bodies in their flight through the heavens—and the appearance they present certainly warrants such an assumption—yet this is not the only way in which these tails may be accounted for. They may be simply an effect produced by the comet on the material through which it is passing; an effect analogous to that which we sometimes see produced by a very small insect on the surface of still water. We see a dark spot, and on looking closer we find a small fly or moth flapping its wings and creating a disturbance which was visible before the insect which produces it.

There is nothing else that we can conceive their tails to be, so that they must be one or other of these two things; either—

(1) Material appendages of the nucleus, whether the material be limited to the illuminated tail or surround the comet on all sides.

(2) Matter which exists independently of the comet, and on which the comet exerts such a physical influence as to render it visible.

Respecting the composition of these bodies, Sir John Herschel says:—"There is, beyond question, some profound secret and mystery of nature concerned in the phenomenon of their tails. Perhaps it is not too much to hope that future observation, borrowing every aid from rational speculation, grounded on the progress of physical science generally (especially those branches of it which relate to the ætherial or imponderable elements) may ere long enable us to penetrate this mystery, and to declare, whether it is matter in the ordinary acceptation of the term that is projected from their heads with such extravagant velocities, and if not impelled at least directed in its course by reference to the sun as a point of avoidance. In no respect is the question as to the materiality of the tail more forcibly pressed on us for consideration than in that of the enormous sweep which it makes round the sun in perihelio, in the manner of a straight and rigid rod, in defiance of the law of gravitation, nay, even of the received laws of motion, extending (as we have seen in the comets of 1680 and 1843) from near the sun's surface to the earth's orbit, yet whirled round unbroken; in the latter case through an angle of 180° in a little more than two hours. It seems utterly incredible that in such a case it is one and the same material object which is thus brandished. If there could be conceived such a thing as a *negative shadow*, a momentary impression made upon the luminiferous æther behind the comet, this would represent in some degree the conception such a phenomenon irresistibly calls up. But this is not all. Even such an extraordinary excitement of the æther, conceive it as we will, will afford no account of the projection of lateral streamers, of the effusion of light from the nucleus of the comet towards the sun; and its subsequent rejection of the irregular and capricious mode in which that effusion has been seen to take place, none of the clear indications of alternate evaporation and condensation going on in the immense regions of space occupied by the tail and coma—none, in short, of innumerable other facts which link themselves with almost equally irresistible cogency to our ordinary notions of matter and force."

There can be no doubt that if these tails are matter moving with the comet, this matter must be endowed with properties such as we not only have no experience of, but of which we can form no conception. This alone would seem a sufficient reason for rejecting the first hypothesis. Moreover, on the second hypothesis there is no difficulty in the immense velocity with which these tails are projected from the head or whirled round when the comet is in perihelio. For to take the "negative shadow" as an illustration, here we should have a velocity of projection equal to that of light, and the only effect of the whirling would be a slight lagging in the extremity of the tail, causing curvature similar to that which actually exists. And whatever the action may be, if its velocity of emission or transmisson be sufficiently great, this effect will be the same; but whether this hypothesis is to be rejected because involving assumptions beyond conception or contrary to experience, must depend on the answers to the following question—Do we know, or can we conceive, any physical state into which any substance which can be conceived to occupy the space traversed by comets could possibly be brought so as to make it present the appearance exhibited by comets?

Now, I think the answer must be in the affirmative, and that we may leave out the terms conceive and conceivable. For electricity is a well-known state, and gases are well known substances; and when electricity, under certain conditions, as in Dr. Geissler's tubes, is made to traverse exceedingly rare gas, the appearance produced is similar to that of the comets' tails; the rarer this gas is, the more susceptible is it of such a state, and, so far as we know, there is no limit to the extent of gas that may be so illuminated. Hence we may suppose the exciting cause to be electricity, and the material on which it acts and which fills space to have the same properties as those possessed by gas. What is more, we can conceive the sun to be in such a condition as to produce that influence on this electricity which should cause the tail to occupy the direction it does. For such an electric discharge will be powerfully repelled by any body charged with similar electricity in its neighbourhood.

The electricity would be discharged by the comets on account of some influence which the sun may have on them, such an influence being well within the limits of our conception.

The appearances of the comet in detail, such as the emission of jets of light towards the sun and the form of the illuminated envelope, are all such as would necessarily accompany such an electrical discharge.

In fact, if the possibility of such a discharge is admitted, I believe it will explain all the phenomena of comets. As to the possibility, or even the probability, of such a discharge, I think it may be established on very good grounds.

The tails of comets may or may not be one with their heads; but whichever is the case, it is certain that the difference in the appearance of comets and of planets indicates some essential difference either in the materials of which these bodies are respectively composed, or else in the conditions under which their materials exist. Now from the motion of comets we know that their heads follow the same laws of motion and gravitation as all other matter, and therefore we have good evidence, so far as it goes, that comets and planets are similarly constituted as regards materials. And since the appearance of a comet changes very much as it passes round the sun, any assumptions with regard to the material of comets in order to account for their difference from planets would not account for the variety of appearance the same comet presents at different times. On the other hand, the conditions of comets and planets must necessarily be very different, from the extreme difference in the shapes of the orbits they describe. Each planet remains nearly at a constant distance from the sun (whatever that distance may be), so that the heat or any physical effect the sun may have upon it will also be constant; on the comets its action must change rapidly from time to time, particularly when the comet is in certain parts of its orbit. Hence we may say that the temperature and general physical condition of planets is nearly constant, and that of comets for the most part continually varying.

There is, too, a very remarkable connection between the appearance of the comet and the rate at which the sun's action on it changes. Herschel says:—"Sometimes they first make their appearance as faint and slow moving objects, with little or no tail, but by degrees accelerate, enlarge, and throw out from them this appendage, which increases in length and brightness till (as always happens in such cases) they approach the sun and are lost in his beams. After a time they again emerge on the other side, receding from the sun with a

velocity at first rapid, but gradually decaying. It is, for the most part, after thus passing the sun that they shine forth in all their splendour, and their tails acquire their greatest length and development; thus indicating plainly the sun's rays as the exciting cause of that extraordinary emanation. As they continue to recede from the sun their motion diminishes and their tail dies away, or is absorbed into the head, which itself grows continually feebler, and is at length altogether lost sight of."

Here, although unconsciously, Herschel has connected the increase of brightness with the increase of speed with which comets approach the sun, and the diminution in brightness, with the diminution of the velocity with which they leave the sun. And although from Herschel's remark just quoted it might be inferred that proximity to the sun is the cause of the increase of brightness, this is proved not to be the case, for (as in the case of Halley's comet) when near its perihelion the tail always dies away, and the comet shrinks. Thus when the comet is nearest to the sun there is no development of tail, which shows clearly that it is not the intensity of the sun's rays but the change in their intensity that is the exciting cause of these extraordinary appearances. So that there is no reason to suppose that a planet composed of the same material as a comet, no matter how close to the sun, would show a vestige of tail or other cometic appearance.

It is, then, to this change in position that we must attribute those peculiar appearances which belong to comets.

Now, is not electricity the very effect which would naturally result from such a state of change and variation in condition?

A. De la Rive remarks, "Electricity is one of the most frequent forms which the forces of nature assume in their transformations. It certainly often accompanies a change in temperature. There is every indication that it is so in our atmosphere, for the times when its intensity is a maximum are just after sunrise and just after sunset, both winter and summer.

From these reasons it seems to me not only possible but probable that these strange visitors to our system are clothed in electrical garments with which the regular inhabitants are unacquainted.

The electricity must, after all, depend on the composition of the comet, for known substances do not all show the same electrical properties. Hence, by assuming comets to be composed of various materials, we have a source to attribute the different appearances presented by the different individuals. To the same source we may attribute the irregularity in the direction of their tails and the lateral streamers they occasionally send out.

Secondly, I think this electrical hypothesis is supported by the, to me, seeming analogy between comets, the corona, and the aurora; an analogy which suggests that they must all be due to the same cause. They may be all described as streams of light, or streamers, having their starting point more or less undefined, and traversing spaces of such extent and with such velocities as entirely to preclude the possibility of their being material in any sense of that word with which we are acquainted.

The aurora has long been considered as an electric phenomenon, and recently the same effect has been produced by the discharge of electricity of very great intensity through a very rare gas, there being no limit to the space which it will thus traverse. This being so, why should not the tails of comets and the corona also be electric phenomena? Their appearance and behaviour correspond exactly with those of the aurora, and there is surely nothing very difficult in imagining the sun which is the source of so much heat being also the source of some electricity. Neither will there appear anything wonderful in the electricity of comets when we consider that of the earth. We must not look on our inability to explain the cause of such an electric discharge as fatal to its existence, for we cannot any more explain the existence of the electricity which causes the aurora. If we cannot explain from whence these electricities come, we can at least show that the conditions which are most favourable to the development of the aurora exist in much greater force on the comets than they do on the earth. The greatest development of the aurora borealis takes place at the equinoxes. There is a cessation in summer, and another in winter. Now, the equinoxes are the times when the action of the sun on our northen hemisphere is changing most rapidly. Hence the condition favourable for the aurora is changed in the action of the sun. The same thing is pointed out by the diurnal variation in the electricity of the atmosphere. Now, as has been already shown, the change in temperature on the comets is incomparably greater than it is on the earth, and its variation corresponds with the variation in the splendour of the comet.

Angström has also shown that the light from the aurora, the corona, and the zodiacal light, are all of the same character, or all give the same bright lines when viewed through the spectroscope, and that these lines correspond to the light from no known substance. This indicates that whatever this light may be, the incandescent material is the same in all cases; or may we not assume that it is the medium which fills space that is illuminated by the electric discharges? This would be supported by the fact that the light from the heads of two small comets indicated carbon, whereas that from the tails only gave a faint continuous spectrum. For an electric discharge would first illuminate the atmosphere of the comet, or even carry some of the solid material off in a state of vapour, and then pass off to the surrounding medium. Thus, while the spectrum from the head would be that of cometary matter, the tail would be due to the incandescent ether.

I would here suggest that gas, when rendered incandescent by electricity, may reflect light—it will certainly cast a shadow from the electric light—and if this be the case, part of the light from comets' tails may after all be reflected sunlight.

At any rate, it is certain that the appearance of streamers, the rapidity of change and emission, the perfect transparency and the wave-like fluctuations which belong to these phenomena, are all exhibited by the electric brush; in fact, the electric brush will explain all the appearances, which have defied all attempts at explanation on a material hypothesis.

I have only to add that the main assumption involved in the electric theory is, that space is occupied by matter having similar electrical properties to those of these; and I would ask, is it not more rational to make such an assumption than it is to attribute unknown and inconceivable properties to cometary matter?

Theories even, if founded only on rational speculation, often, I believe, prove very useful, insomuch as they afford observers a definite purpose in their observations—something to look for, something to establish or to refute; and I publish these speculations of mine at this particular moment in the hope that they may perchance serve such a purpose.

"*On Iso-di-naphthyl*," by WATSON SMITH, F.C.S. Communicated by Professor ROSCOE, F.R.S.

About the commencement of the month of March, 1870, when endeavouring, on the suggestion of Mr. John Barrow, in whose laboratory I was then engaged, to obtain anthracene by the action of a red heat upon naphthaline, the vapour of this body being passed through a red-hot tube, I found that, instead of the anticipated result occurring, according to the equation—

$$7C_{10}H_8 = 5C_{14}H_{10} + 6H,$$

a body was obtained which had a *melting-point* and also a *boiling-point* pretty nearly agreeing with those of anthracene, but almost all its other properties were dissimilar to those characterising that body.

This substance I found to fuse at from 200° to 204° C., its boiling-point lying over that of mercury considerably, and also over that of anthracene as nearly as I could judge. It is difficultly soluble in alcohol and ether, more

soluble in carbon tetrachloride and benzol, freely soluble, even in the cold, in carbonic disulphide and oil of turpentine.

From all the above solutions except that of the turpentine it crystallises in beautiful silky rhomboidal plates, which, on drying, interlaminate, and possess a delicate light yellowish green colour and silky lustre. From the turpentine it crystallises in beautiful white lance-shaped crystals congregating in tufts. Its subliming-point lies considerably below its boiling-point, indeed not far above its melting-point.

It may be obtained perfectly white by carefully subliming the re-crystallised substance at as low a temperature as possible. If the semi-purified body be re-crystallised from any of the above-named solvents, the mother liquors on filtering are found to have acquired a beautiful blue fluorescence, but the perfectly pure substance no longer yields a fluorescent solution.

A mixture of two parts of potassium bichromate and sulphuric acid, cause energetic oxidation of this substance, but no colouring matter is obtained by treating the product of oxidation so obtained, by Perkin's method for obtaining alizarin from anthrachinon.

Cold sulphuric acid is without action upon it. Warm sulphuric acid dissolves it, if pure, with a slight purplish colour. If containing any of the yellow substance which always contaminates the crude body, the warm acid assumes a blue colour. which, on further warming, becomes green and then brown.

Nitric acid oxidises it, with liberation of nitrous fumes.

Chlorine passed over it in the cold does not affect it, and apparently not even on slightly warming.

I find that it is impossible to distil naphthalin to dryness in any quantity, without this body being formed in minute quantity. If an appreciable quantity be not obtained on first distillation, it will be by transferring back the distillate to the retort and again distilling to dryness; a minute quantity of high boiling residue will then be obtained, raising the temperature towards 300° C.

A quantity of the pure substance, submitted to organic analysis, furnished the following numbers:—

Grms.

I. 0.1240 grm. of substance gave 0·4307 CO_2 and 0·0624 H_2O.

II. 0·1237 „ „ 0·4284 CO_2 0·0626 H_2O.

	I.	II.	Calculated for $C_{10}H_7$ $C_{10}H_7$
Carbon	94·72	94·46	94·49
Hydrogen	5·59	5·62	5·51
	100·31	100·08	100·00

The hydrogen evolved in the process was collected and measured, and the following calculation made:—

Weight of naphthalin converted 26·30 grms. (nearly).
Volume of hydrogen at 0° C. .. .. = 2359·7 c.c.
= 0·2107 grm. H.

$$\overbrace{2C_{10}H_8}^{256} = \left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\} \overbrace{+\ H_2}^{2} \quad \therefore\ 26{\cdot}3 \text{ grms. lose } 0{\cdot}2055 \text{ grm. H.}$$

Hydrogen actually liberated .. .. = 0·2107 grm.
Hydrogen calculated as above.. .. = 0·2055 grm.

For the formula $7C_{10}H_8 = 5C_{14}H_{10} + 6H = 0{\cdot}1861$ grm. of H. must be liberated.

From these considerations, and seeing that the properties of the body considerably differ from those of di-naphthyl as obtained by Dr. F. Lossen,* I propose to regard this body as an isomer, and propose to name it accordingly *Iso-di-naphthyl.*

* *Ann der Chemie und Pharm.*, Band cxliv. 71, 1867.

NOTICES OF BOOKS.

A Cyclopædia of Quantitative Chemical Analysis. By FRANK H. STORER, A.M., Professor of General and Analytical Chemistry in the Massachusett's Institute of Technology. Part I. Boston and Cambridge (U.S.): Sever, Francis, and Co. London: E. and F. N. Spon. 1870.

THIS work will be welcomed by all who take an interest in chemistry as a step in the right direction. In compiling the book, the object of the author (well-known to the scientific public as an accomplished *savant* and an excellent editor of several valuable works) has been not only to provide the student and working chemist with a comprehensive dictionary of quantitative processes, but to call the attention of the chemical fraternity to the question of the possibility of presenting this branch of chemistry in a more serviceable and manageable form than has been customary hitherto. The work, indeed, in its first edition is to be considered as an experiment only. The substances are classified in alphabetical order, and every process is referred to the fundamental fact or principle upon which it depends. As instances of the method adopted by the author we give the following extracts:—

ACETIC ACID.—*Principle I.* Power of neutralising alkaline solutions. *Applications:* Estimation of free acetic acid in vinegar, pyroligneous acid, and other aqueous solutions (Method A); Determination of acetic acid in certain acetates from which caustic soda precipitates insoluble hydrates or oxides (Method B). *Method A.*—A weighed or measured quantity (10 grms. of vinegar will be enough in most cases) of the solution to be examined is reddened slightly with litmus, and then treated with test-alkali until the whole of the acid is neutralised, and the colour of the litmus changed to blue (see Acidimetry).

ANTIMONY [Compare antimony compounds.]—Antimony is estimated as metallic antimony, as sulphide of antimony, antimoniate of antimony, antimoniate of sodium, or by titration, as has been explained under antimonious acid. *Principle I.* Sparing solubility of the metal in chlorhydric acid.

CANTHARIDIN.—*Principle.* Sparing solubility in bisulphide of carbon and in alcohol.

CARBONATE OF LEAD.—*Principle I.* Insolubility in cold water. *Applications:* Estimation of lead in all salts of that metal which are soluble in water, or from which the lead can be dissolved by nitric acid; separation of Pb. from Mn.

These few instances may give the reader some idea, though a very inadequate one, of the mode of treatment of the matter and arrangement of the subject. It would be impossible to enter into minute details of this work, which indeed, when completed, will be for analytical chemistry what Watts's "Dictionary" is for chemistry in general. It is not only important that the analyst should have a dictionary of all known methods from which to choose the one which seems best to fulfil the conditions and requirements of any new problem which may come before him, but there will always be needed books or tables devoted to illustrations of the various kinds of analyses which are likely to occur in practice. But if we were once in possession of a general encyclopædia covering the entire field of analysis, it would be easy to draw up long lists of these special schemes in a very few words. For example: A residual product from some of the chemical works at Stassfurt, in Germany, sent into commerce to be sold as a fertiliser, contains the sulphates of potassium, magnesium, and calcium; the chlorides of potassium, sodium, and magnesium, and a quantity of oxide of iron, magnesia, and sand, insoluble in water. But the commercial value of any given sample of the substance depends upon the proportion of potassium which is contained in it. Several methods

have been employed for estimating the potassium. After the matters insoluble in water have been got rid of by filtration, they might be briefly described as follows: (*a.*) Remove the SO_3 with $BaCl_2$, as sulphate of barium, the Mg with BaO,H_2O, as hydrate of magnesium, the Ca and excess of Ba with $(NH_4)_2O,CO_2$ as carbonate of barium, and estimate the K as chloride and chloroplatinate of potassium. (*b.*) Remove SO_3 by means of $BaCl_2$ as sulphate of barium, decompose the chloride of magnesium with oxalic acid, and separate Mg as oxide of magnesium; determine K as chloroplatinate of potassium. (*c*). Remove the SO_3 with $BaCl_2$ as sulphate of barium; the Ba, Ca, and Mg with Na_2OCO_2 as carbonate of barium, &c., acidulate the filtrate with HCl, and estimate K in the filtrate as chloride and chloroplatinate of potassium. (*d.*) Remove the SO_3 with $BaCl_2$ as sulphate of barium, and estimate K in the filtrate as chloroplatinate of potassium (Stohmann's process). The author of any such tables would of course give reasons why and when either one of the processes would be preferred to the others. In the appendix to the work now under notice, the author intends to give a few examples of this kind of analysis for students' practice.

The names of rare elements have been omitted from this edition simply for want of time to deal with them; and in order that the size and cost of the book might be kept within reasonable bounds it has been thought best to exclude from it all figures of apparatus, but the description of unusual forms of apparatus has been given in minute detail, so that any reader may, if he chooses, by reading the text attentively, make from the description a rough figure for his own use.

Professor Storer's work cannot fail to be a great boon to all chemists, and for compiling it we feel greatly indebted to the talented author. We trust that both the author and publishers will find their labours duly appreciated.

Chemical Problems. By Professor T. E. THORPE, Ph.D., Manchester: J. Galt and Co.

WE are glad to welcome this little book. It is introduced by a short preface from the pen of Dr. Roscoe, who says that he feels sure "that by no method can accuracy in a knowledge of chemistry be more surely secured than by attention to the working of well-selected problems,"—and we are quite sure that Professor Roscoe is right. We believe that Dr. Roscoe was one of the first to recognise the value of such questions, and many of our best teachers, whose papers formerly contained questions requiring merely descriptive answers, now largely employ them, and it is certain that a candidate at the examinations of the Science and Art Department, or the examinations of the University of London, cannot hope to succeed unless he possess some facility in chemical calculations.

Dr. Thorpe's little book contains 220 questions. They are well selected, and cover a considerable range, and in the case of those presenting any difficulty, explanations are given.

Most of the questions are new, but some few are taken from the examination papers of the Science and Art Department.

We notice an error in the formula for the calculation of the *calorific intensity* of hydrogen burning in oxygen, which is given thus:—

$$\frac{34462-(536\times 9)}{9\times 0{\cdot}475}=6932{\cdot}8.$$

Since the initial temperature of the gases is supposed to be 0° C.—the latent heat of steam at 0° C. must be employed and not that at 100° C., so that the formula should be—

$$\frac{34462-(606{\cdot}5\times 9)}{9\times 0{\cdot}475}=6784{\cdot}3.$$

We notice one other error—a misprint— on page 3. Area of a circle = diameter squared $\times 0{\cdot}785938$ should be = diameter squared $\times 0{\cdot}785398$.

The value of the book is increased by an appendix giving a table of four figure logarithms and anti-logarithms, a table of atomic weights, and other tables of constant use in calculations.

CORRESPONDENCE.

NITRIC ACID DISSOLVES TIN.

To the Editor of the Chemical News.

SIR,—Having been aware for a long time that a mixture of nitric and hydrochloric acids, in the proportions of 12 parts by volume of the former to 1 part by volume of the latter, diluted with 13 parts by volume of water, was capable of dissolving tin in very large quantity, I bethought me of determining whether nitric acid alone had any solvent action upon that metal. Accordingly I mixed equal volumes of chemically pure nitric acid and pure water, and having poured into a clean test-tube a sufficiency of the mixed acids to ballast it and cause it to float upright in water, I set it afloat in that fluid, at a temperature of about 36° Fahrenheit. Taking care to keep the liquid cold, I added a fragment of pure tin of the size of a pin-head, which dissolved within an hour. Fragment after fragment dissolved in like manner, and the solution thus obtained was of a brilliant yellow colour, and perfectly transparent. Upon the application of a very gentle heat to the solution the colour disappears, and at the boiling-point the whole of the tin is precipitated as the hydrate of metastannic acid. To examine this nitric acid solution of tin it would be necessary first to pass through it a stream of dry and cold hydrogen in order to exsiccate the salt and free it from excess of acid, and afterwards to inquire into its properties. Would you oblige me by giving the above discovery publicity through your widely-circulated paper?

I have already mentioned the above facts to several chemists of my acquaintance, and all of them think the matter sufficiently important for notice in your columns. —I am, &c.,

GEORGE HAY.

31, Grove Street, Edinburgh.

SUPERSATURATED SALINE SOLUTIONS.

To the Editor of the Chemical News.

SIR,—I have to thank Mr. Tomlinson for the courteous tone in which he has criticised my last paper upon supersaturated solutions.

Just at present I have not time to answer his objections, but shortly I hope to do so fully. But with respect to the doubt which Mr. Tomlinson raises as to the non-supersaturation of the solutions experimented upon, I can only repeat what I have already twice stated (see CHEMICAL NEWS, vol. xxii., pp. 91 and 243), *i.e.*, that I took every conceivable precaution to ensure the solutions being fully supersaturated, and that I never accepted a result until I had proved this either by exposure to the air or by the insertion of a dirty rod, and, moreover, I almost invariably worked with such an excess of salt that some was thrown down in the anhydrous form during the boiling; hence this source of error was, I think, eliminated.

It would have been perfectly useless to have made experiments upon a solution which was not supersaturated. The discordancy between my results and those obtained by Mr. Tomlinson must, as far as I can see, be explained in some other way.

In reply to Mr. Tomlinson's inquiry respecting the strength of the ethereal solutions—I may state the proportions were approximately one part oil to twenty of ether.—I am, &c.,

ARCHD. LIVERSIDGE.

Christ's College, Cambridge, December 6, 1870.

MISCELLANEOUS.

King's College.—Mr. C. L. Bloxam has been appointed Professor of Chemistry in the room of the late Dr. W. A. Miller, and Mr. W. Noel Hartley has received the appointment of Demonstrator.

The Chair of Chemistry at St. Bartholomew's Hospital.—On Tuesday morning last, the candidates for the chemical chair at St. Bartholomew's Hospital were summoned to meet the House Committee of the Hospital. The following gentlemen attended:—Messrs. Dupré, Heaton, Mills, Russell, Maxwell Simpson, and Wanklyn. After waiting in the ante-room for about an hour and a half, the candidates were called into the board room one by one, seated on a high chair, and personally "interviewed" by the House Committee. Then Mr. Cross, secretary to the Hospital, read the letter of application, and the candidate was asked if he had anything to add to the letter. In most cases he was asked a variety of questions —"His age," "Whether he could manage boys," &c., and having replied to these interrogatories he was requested to withdraw. After a slight pause, Mr. Cross called in the successful candidate and communicated to the others the name of their more fortunate companion. The name announced was that of Dr. Russell, of St. Mary's Hospital. We are told that the usual steps in the election to the chemical chair at St. Bartholomew's are—recommendation by the Medical Committee of the Hospital, election by the House Committee, consisting of some thirty governors, and confirmation by the general body of governors, which numbers some 270 persons.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Zeitschrift für Chemie von Beilstein, No. 17, 1870.

Action of Phosphuretted Hydrogen upon Zinc-Ethyl.—C. Schultz-Sellack.—It is, says the author, a well-known fact that, ammonia decomposes an ethereal solution of zinc-ethyl, forming zinc-amide. When phosphuretted hydrogen acts on an ethereal solution of zinc-ethyl, there is obtained a yellowish powder, which is not analogous to the zinc-amide just alluded to—viz., primary zinc-phosphine, but a substance containing carbon, so that the ether is simultaneously decomposed, as is also the case when phosphuretted hydrogen acts upon ether and chloride of cyanogen, as stated by MM. Darmstädter and Henniger.

Cyanchlorhydrine of Ethyl-Glycerine; and on Monochloro-Lactic Acid.—G. Glinsky.—This paper opens with a brief *resumé* of the author's researches on the action of hypochlorous acid upon chlorvinyl. When an aqueous solution of chloraldehyde was treated with cyanide of potassium, a brown-coloured oily fluid, which is readily decomposed, was obtained, which appeared to be a fluid cyanaldehyde. This body gave, when treated with hydrochloric acid, a large quantity of sal-ammoniac, and, when afterwards treated with ether, yielded chloro-lactic acid. The probable mode of formation of this body is elucidated by a series of formulæ too lengthy and complicated for us to quote. The next following section of this paper is devoted to the detailed description of the preparation of the cyanchlorhydrine of the ethylglycerine, which preparation is commenced with the reaction of hydrochloric acid upon chlorvinyl. This yields by fractional distillation several liquids, which boil at temperatures varying from 22° to 97°. When any liquid ceases to come over at that temperature another receiver is put on, and the distillation resumed at above 97°, and continued as long as the fluid collected in the receiver becomes emulsified when dry pulverised cyanide of potassium is added to it. After being properly purified (a somewhat lengthy and tedious operation), the resulting liquid is an oily fluid of agreeable smell, sweet, but burning taste, not capable of being boiled without decomposition even in vacuum, burning with a greenish coloured flame, soluble without producing any evolution of gas in nitric and hydrochloric acids; yielding, however, with the latter—chlorolactic acid. The formula of this body, cyanchlorhydrine of ethylglycerine, is C_5H_4ClNO. The author then treats at length on the preparation of monochloro-lactic acid, and further states that chlorolactic acid, $C_3H_4ClO_3$, is a solid body, crystallising in irregular shaped foliated crystals, colourless and void of smell, readily soluble in water, alcohol, and ether, fusing at 81°. It is a rather strong acid, which dissolves zinc, sublimes with partial decomposition and yields with zinc two salts, viz: (1.) $(C_3H_4ClO_3)_2Zn+3H_2O$, a solid, crystalline, efflorescent body, which, on being boiled with water, yields aldehyde; if heated above 100° the salt becomes brownish coloured, and at 190° it is decomposed, yielding aldehyde. (2.) $(C_3H_4ClO_3)_2Zn+3\frac{1}{2}H_2O$, obtained by dissolving zinc at 50° in the concentrated aqueous solution of the acid, exhibits small, irregular-shaped crystals. The silver salt of this acid, $C_3H_4ClAgO_3$, is very difficult to prepare, since it is very readily decomposed by the action of heat and light. The salt crystallises in the shape of tufted acicular crystals. It is very prone to decomposition, for even when in hot water, it is resolved into carbonic acid, chloride of silver, and aldehyde.

Oxyisocaprylic Acid, Oxyisovalerianic Acid, and Dipseudopropyl-keton.—W. Markownikow.—The author, describes the following substances: oxyisocapryl ether; $C_8H_{15}(C_2H_5)O_3$, a thickish, pale, yellow-coloured, mouldy-smelling fluid, boiling at about from 202°—204°; is not acted upon by a concentrated solution of caustic potassa at 130°. This ether is best decomposed by alcoholic potassa. It then yields, after proper purification, the oxyisocaprylic acid $\left.\begin{matrix}C_2H_7\\C_2H_7\end{matrix}\right\}C(OH)CO_2H$, a solid body, crystallising in needle-shaped crystals, difficultly soluble in cold water, more readily so in alcohol and ether; fuses at about 110°. The barium salt of this acid $(C_8H_{13}O_3)_2Ba+3H_2O$, is a crystalline, efflorescent body. Oxyisovalerianic acid (pseudopropyl-hydroxalic acid), $C_2H_7.CH(OH)CO_2H$, is soluble in ether, very deliquescent, and yields with barium an anhydrous salt, obtainable in semi-crystalline state. The formula of this salt is $(C_5H_9O_3)_2Ba$, soluble in alcohol. The formula of the silver salt is $C_5H_9O_3.Ag$, difficultly soluble in cold water. Dipseudopropyl-keton, $(C_3H_7)_2.CO$, a fluid exhibiting a peculiar and strong smell. It is soluble in water and does not combine with sodium bisulphite. It boils at 123°. The author briefly states that oxyisocaprylic acid, when heated to 100° with fuming hydriodic acid, does not yield isocaprylic acid, but several iodides, amongst which is isopropyl-iodide.

Behaviour of Some of the Haloid Compounds of Ethylen and Propylen with Hydriodic Acid.—W. Sorokin.—The author first states that since Dr. Markownikow had proved that when hydracids (haloid acids) combine with hydrocarbons, C_nH_{2n}, the haloid always prefers to combine with that C-atom which is bound to the smallest quantity of H; he therefore endeavoured to try to determine by experiments how, and in what manner, two haloids would simultaneously combine with an unsymmetrical hydrocarbon. This having been premised, the author describes in detail a series of experiments, which, however interesting, are not suited for abstraction.

Hydrocarbons, C_5H_{12}.—M. Lwow.—Of the hydrocarbons C_5H_{12}, three are theoretically known. Of these three, the second, obtained from amylic alcohol, is somewhat better known. The formulæ of these hydrocarbons are:—

(1) $CH_3—CH_2—CH_2—CH_2—CH_3$,

(2) $CH_3—CH(CH_3)—CH_2—CH_3$

(3) $C(CH_3)_4$

The author has prepared the third member of this group—the tetramethylformen, a body answering to the formula—

$$2C(CH_3)_2I+Zn(CH_3)_2=C(CH_3)_4+ZnI_2.$$

Zinc methyl is added drop by drop to the tertiary iodbutyl (the iodide of trimethylcarbinol); after a tedious process of purification there is obtained tetramethylformen, C_5H_{12}, a colourless, very mobile fluid, boiling at 9·5°, solidifying at −20° to a crystalline body, very similar to sublimed sal-ammoniac. This property of becoming solid and crystalline distinguishes this substance from hydride of amyl. The vapour density of this substance is = 2·493.

Haloid Compounds of Boron.—G. Gustavson.—Chloride of boron is readily prepared when boric acid anhydride is heated in a sealed tube for three or four days to 150°, with twice its weight of pentachloride of phosphorus. In addition to BCl_3, there is also formed an oxychloride of boron. Terchloride of phosphorus does not act upon boric acid anhydride even when heated therewith to 200° for a period of three weeks. Chloride of boron can be distilled over sodium without decomposition, and when the temperature is raised to 150°, only a trace of free boron is separated. Pulverised metallic zinc does not act upon chloride of boron even at 200°.

Action of Phosgen on Zinc Methyl.—A. Butlerow.—The author first refers to some of his former experiments on this subject, stating that zinc methyl absorbs at the ordinary temperature very slowly, and somewhat more rapidly at 100°, phosgen, $COCl_2$, the result being the production of a crystalline compound, $[2Zn(CH_3)_2.C_2H_3O.Cl]$, which, on being decomposed by means of H_2O, yields trimethylcarbinol. But since simultaneously some acetic acid is formed, the author was induced to study the reaction alluded to more particularly. The greater portion of this paper is devoted to a detailed account of the experiments instituted for the special purpose of determining the moment when acetic acid is formed. The result of careful investigation in this direction was, however, negative. The author therefore comes to the conclusion that the acetic acid formerly noticed was due to the decomposition of trimethylcarbinol.

Constitution of Some Non-saturated Hydrocarbons.—A. Butlerow.—The introduction to this paper treats on the theory of the constitution and atomic and molecular structure of the hydro-

carbons, which are termed non-saturated. The greater portion of the essay is, however, devoted to a lengthy description of a series of experiments made with the view of elucidating the various theories which have been propounded on the subject.

Some of the Reactions Exhibited by Mercurallyl. — M. Krawsowsky.—The author states that at the suggestion of Professor Butlerow (University of St. Petersburgh) he was induced to try to prepare some derivatives of the combination $(C_3H_5)HgI$, and also the bodies $(C_3H_5)_2Hg$, and $(C_3H_5)(C_3H_5)Hg$. The two last-named could not, however, be made. When a mixture of 15 grms. C_3H_5I, and 1½ grms. of acetic ether were heated with sodium amalgam, there was formed $(C_3H_5).HgI$, a volatile body exhibiting the smell of diallyl. If $Hg(C_3H_5)I$ is heated to 100° in a sealed tube, along with an aqueous solution of KI, there is formed diallyl and Hg, $2C_3H_5(Hg)I+2KI=C_6H_{10}+Hg+HgI_2.2KI$. The author states further that when a mixture of $(C_3H_5)HgI$ and C_3H_5I is heated for three days with iron filings up to 100° in a sealed tube, the greater portion of the $(C_3H_5)HgI$ remains unchanged. With pulverised zinc the result is somewhat different, for when $Hg(C_3H_5)I$ is treated with $Zn(C_3H_5)_2$, Hg is separated and mercurethyl formed without evolution of any heat or gas. The reaction is represented by—

$$2Hg(C_3H_5)I+Zn(C_3H_5)_2=Hg(C_3H_5)_2+Hg+C_6H_{10}+ZnI.$$

Recovering of Iodine from Substances which Contain that Element. — Dr. F. Beilstein. — The author first states that when only iodine is present, the separation of that substance does not involve any difficulty, and therefore the process to be detailed refers to the separation of iodine from substances simultaneously containing bromine and iodine. The sufficiently concentrated saline solution (containing of course iodides, bromides, and perhaps chlorides) is acidified with sulphuric acid, and a current of nitrous acid gas, obtained by heating one part of starch (dry) with six parts of crude nitric acid, is then introduced into it. This operation requires cautious management, so as to obtain a regular supply of gas. The effect upon the solution is the separation of iodine, which is separated by filtration, as directed by Bunsen, washed with cold water, and dried over sulphuric acid. If it is desired to separate the bromine, if present, the filtrate is first heated in a basin, for the separation of any iodine which might have been left dissolved, and the fluid is then distilled, with a mixture of sulphuric acid and manganese.

NOTES AND QUERIES.

Orange-Lead.—Can any of your correspondents favour me with particulars of the manufacture of orange-lead, or of any published work from which such may be obtained.—J. DODD.

Separation of Tarry Matter from Gas-Water.—Can any of your readers inform me of a good mechanical method for separating suspended tarry matter from gas-water, of from 8° to 10° Twad., obtained by passing the water a number of times through the "scrubbers."—GAS ENGINEER.

Pyrotechny.—(Reply to Ernest J. Whiteford).—Consult Schubarth's "Standbuch der Technischen Chemie," vol. i. Under the heading of "Powder Manufacture," you will find a rather complete bibliography on your subject. You will find the work at the library of the Commissioners of Patents.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)
—— Medical, 8.
TUESDAY, 20th.—Institute of Civil Engineers, 8. (Anniversary.)
WEDNESDAY, 21st.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 22nd.—Royal, 8.30.
FRIDAY, 23rd.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

*** Our Publisher requests us to remind Subscribers that, if their Subscriptions for the ensuing year are sent to him in advance, the amount for one year will be 18s., no postage being charged; but if accounts are sent from the Office, the subscription will be £1.

Climax.—You will find the tables you require in the appendix to Miller's "Elements of Chemistry."

A Reader.—Write to the Secretary, Burlington House.

W. King, W. H. Dean, and others.—The work on "Dyeing" is not published yet; it will be announced as soon as it is ready.

A Constant Reader.—You need not hesitate to place dependence upon anything issuing from the principal of the firm you name.

J. Fordred.—Your communication has been received.

W. F. Q.—Griffin's "Chemical Handicraft" will give you particulars of several of the furnaces.

L. M. Montgomery.—Your best plan would be to get a copy of the journal from which our notice was taken.

W. Hope.—Received, with thanks.

A. and M. Zimmerman.—Received.

J. Bottomley.—Your communication is unavoidably postponed till next week.

Rev. H. Highton, M.A.—Next week.

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Challenge to the World.—The *Bristol Daily Times and Mirror*, August 5th, has the following:—Messrs. J. C. Swan and Co., of 16, Queen's Square, in this city, have invented a pocket microscope, which is a marvel in all that such an instrument should be. It has great power, remarkable definition, and does not require focussing. The cheapness of the article will make it exceedingly popular when its merits are more widely known. It is called the "Bristol Microscope," and is a great credit to the inventor, as much for its extreme simplicity as its power.—The *Western Daily Press* says: The Bristol Microscope has a magnifying power of 20,000 times, &c., &c.—The *Western Daily Telegraph* says: The Bristol Microscope is the most compact and useful scientific instrument we have ever seen; it possesses extraordinary power, and is very easily managed, &c. The price of the Bristol Microscope is only 2s., or free by post, with printed directions, for 28 stamps.—Address, J. C. Swan and Co., Opticians, 16, Queen Square, Bristol.

THE CHEMICAL NEWS.

Vol. XXII. No. 578.

ON THE SEWAGE QUESTION.*

By EDWARD C. C. STANFORD, F.C.S.

(Concluded from p. 291).

Now, in estimating the value of a manure, Her Majesty's Commissioners attach little importance to farmers' certificates, but value it entirely by chemical analysis; this is the only fair way, because it shows exactly what it is worth in open market. But in comparing the value of irrigation with that of any chemical process dealing with sewage they bring in another and, I submit, an improper element, *i.e.*, the total profit of the farmer. This is unfair; the farmer buys his manure—say, made from bones, or, say, from excreta—by analysis at its market value, and his living is made out of what that investment produces from the land. The irrigationists have no right to put themselves in his place, reap his profits, charge themselves nothing for the sewage, and call that "making it pay." In one of the accounts quoted in Her Majesty's Commissioners' Report, I see the "right of shooting over the farm" actually entered as an irrigation profit! What will the farmer give for the sewage? Of course, much less than its analytical value, where, as with us, the water is not wanted. Farmers in the west of Scotland, although, no doubt, they can grumble as well as their English friends, very seldom have to grumble for want of water; and, at any rate, in their case, the value of the manurial matter will be in inverse geometrical proportion to the quantity of water it is dissolved in. I repeat geometrical, not arithmetical.

Our country has got into its sewage difficulties from the extreme persistence with which our engineers have clung to the idea that water is the great purifier. Hence, we began with the water-closet, combined with a cesspool, but the frightful results of this provision for the contamination of our drinking water were soon apparent. We could not stop there, we must go further, and convert the cesspool into a net-work of gigantic sewers.

Instead, therefore, of having one deep cesspool for each house, exposing a comparatively small surface, we now convert these into one shallow stream of large surface and underlying the whole city. Therefore, we can have no more wells; we must draw our drinking water from one great source far away from contamination.

Professor Corfield says our sewers must be porous to the drainage water above, and impervious below. Practically we know that all leak both above and below, the sewer gases diffuse upwards, and the sewer liquids find their way downwards.

Sewage gas will pass easily through brick walls, and the action of the sewage on the soil pipes diffuses them throughout the house. The British Association Committee says that no improvement has taken place in sewer ventilation.

I spoke of water in a former paper as "a mere carrier" of excretal matter; we find it now a most powerful diffuser, spreading far and wide its pollution.

It is idle to talk of carrying the sewage without decomposition to the land. Both the solid and fluid excreta are acid when voided; the former will remain several weeks without decomposition, and the latter several days; mix them or add water, and the mixture becomes alkaline in twenty-four hours, and in that time it absorbs oxygen rapidly, and is in a full state of decomposition. Again, the gases given off from this mixture are of the most dangerous character—light carburetted hydrogen is one; and this is one of the most diffusive gases with which we are acquainted, and we cannot keep it and the poison germs which it diffuses out of our houses. The sickly odour of sewer gas is too well-known in all houses where there are water-closets.

Now I am quite prepared to admit that the water supply and the drainage arrangements are good and may be left for house-washing waters or surface drainage, and the slight amount of oxidation from the surface of the river may be sufficient to purify this. But when we look at this gigantic scheme as a scientific means of removing that small portion of dirt we call house-sewage, I say that our sanitary reformers have been looking at it through a water medium, and therefore seen it highly magnified. I only wonder that they have stopped here, and not always insisted on the removal of our house-ashes by the same means; the amount to be removed is about the same, and it would not pollute the water.

Let it not be supposed that the water-closet can ever be universal; all its evils are aggravated in hot climates, and in very cold climates it is impossible. The bursting of a soil-pipe in a dwelling house is a calamity which would soon put a stop to the use of the closets if it occurred often with us. Even Professor Corfield admits that the water-closet ought always to be ventilated by a window or an outside wall, and all know that a water-closet in a sick room in connection with a main sewer would be highly dangerous.

The healthfulness of irrigated fields is a much disputed question, but Professor Corfield easily dismisses it. I must, however, quote Dr. Spencer Cobbold, F.R.S., as the highest authority on the subject. In a pamphlet on "A New Entozootic Malady arising from the Utilisation of Sewage" he says—"The wholesale distribution of tape-worm eggs by the utilisation of sewage on a stupendous scale will inevitably tend to spread abroad a class of diseases some of which are severely formidable.".

He states that, in Egypt, one-third of the population suffer from a small parasite in the blood; that this disease (Helminthiasis) is "terribly fatal," and that it has already been found by Dr. Harley in this country. He states his conviction that it is quite possible "twenty years hence, this parasitic malady may be as prevalent in this country as it is now known to be in particular sections of the African Continent." Coming from such an eminent authority the pamphlet presents a sufficiently terrible picture to make any sanitary reformer pause and consider if the country should be committed to even the bare possibility of such awful visitations. If many of our Ayrshire friends peruse it, they will resist the threatened inundation of Glasgow tape-worms as they would the most terrible army of invaders. And yet my friend Mr. Hope, V.C.,† of the British Association Irrigation Committee (and the most committed to irrigation), has the pluck to suggest "a convalescent hospital for diseases of the chest in the middle of his sewage fields, guaranteeing to the patients a certain number of irrigations in the month with genuine unadulterated London sewage," "where London beauties might come out to recruit their wasted energies at the close of the season, and, attired in a *costume de circonstance*, with coquettish jack-boots, would, perhaps, at times, listen to a lecture on agriculture from the farmer himself while drinking his cream and luxuriating in the health-restoring breeze." The pictures are somewhat different; Dr. Cobbold would, probably, consider this seeking the "diet of worms." The distinguished advocate of sewage irrigation is not the only "Hope" that has "told a flattering tale." On the other hand, Professor Corfield states that phthisis is greatly decreased by efficient drainage, *i.e.*, I suppose, increased by irrigation swamps.

In carefully reviewing the effects and defects of water carriage, I have been forcibly led to consider that to dry up the excreta is the safest, easiest, and best method of removal; it certainly is the only one by which we can ever expect to realise its full value. Now let us examine what these reports have to say against it.

* Read before the Glasgow Philosophical Society (Sanitary Section), Nov. 9th, 1870.

† I quote from his paper read before the Society of Arts, February 23rd, 1870.

I scarcely know how to criticise the Royal Commission Report on this subject, because their objections apply only to the ash-pit and privy system as carried out in Lancashire, and we must agree with their conclusions, but the evidence does not in the least effect a proper dry closet system such as that I propose. In fact, they speak highly of some places where Moule's earth closets are used.

Professor Corfield, in speaking of the earth closet, admits that "with supervision the closets do not get out of order," but he has to admit, also, that they had to be substituted for water-closets, at "Dorset County School, because the water-closets always got out of order from things being put into them, and from the apparatus being broken," which, he says, was "because they were not simple and self-acting." But Dr. Buchanan describes the effect of the change as to have actually reduced cost of keeping of from £3 to 10s. per annum, and to produce manure worth 15s. per head per annum (which, however, Professor Corfield does not believe possible). A low fever, which visited the town two years following, never entered the school. The simple water-closets he recommends are used at Liverpool, but the supervision is undertaken and the rules *enforced* by the sanitary authority.

In one of the largest cotton mills in Scotland, the owners were obliged to give up the use of water-closets on account of their offensiveness. The cost of the pure water for the closets was £70 per annum; which was worse than lost, as it was returned to foul a pure stream. Dry closets have been substituted, the offensiveness indoors is entirely removed, the purity of the stream is maintained, and the product of the closets realise £150 per annum. Can any evidence be stronger?

As regards pollution of rivers, Dr. Frankland has shown by numerous comparative analyses that the sewage of so-called midden towns is even stronger than that of towns where water-closets are universal. Now this is a result which cannot surprise us when we remember that in all these towns the fluid excreta goes into the sewers; *i.e.* eight-ninths of the pollution, and unaccompanied by the large dilution of water from the closets. In fact, he adds, "connected as the middens usually are with the sewers, no inconsiderable proportion even of solid excrement, partly in solution and partly in suspension, does actually find its way into the sewerage system." One of the British Association Reporters instanced a town where the excreta was collected in ashes and then carted out to repair the roads. I need scarcely say that this is not the dry system we advocate, and I admit at once that if the urine is not to be collected, the dry system is a failure. Moreover, in all the midden towns referred to, from admixture with a large quantity of valueless material, a considerable amount of manure of a poor value is produced; the highest of which, that of Salford, only realises 7d. per head per annum, and 1s. 8d. ton, and in all cases the cost exceeds the produce.

Glasgow is better than this, say 2s. 6d. per ton, and 2s. per head. But even here, from the enormous quantity of ashes mixed with it, the police manure is obliged to be sold at a low price on account of the carriage. The whole system of removal is, however, infamous, and must be highly prejudicial to health. The mistake lies in the material used; instead of being the cheapest and most bulky, it should be the dearest and the least bulky. It is in this direction that I complain of there having been no investigations: we have a large choice of deodorisers, if we deal direct with the material, and without the intervention of water. For while the advocates of a wet system must necessarily use water, those who advise a dry system are not confined to the use of earth, which may not in the end be the cheapest.

The best is, I believe, what I have introduced under the name of X-charcoal, or charcoal derived from carbonised excreta. The quantity required is less than a quarter the amount compared with earth, and every city has its own source of supply; thus the two constant objections to the earth system are at once done away with.

In each of the closets I have a small earthenware urinal with a tube passing under the floor connected with the pan of the closet, and into this the chamber urine of each floor is emptied (this is kept entirely free from odour by two or three good sized pieces of wood charcoal). The total quantity to be dealt with is easily estimated, but as my former estimates, based on Lieurnur's estimate, differ from those adopted by Her Majesty's Commissioners, I append comparative statement, and also that of Professor Parkes, a high authority.

For 100,000 *Persons, Average of all Sexes.*

	Weight in cwts.			Value in £.	
	Lieurnur.	Parkes.	H.M.C.	Lieurnur.	H.M.C.
Fœces ..	78,000	50,919	64,937	5,800	4,263
Urine ..	484,000	814,732	840,637	35,800	28,140
Total ..	562,000	865,651	905,574	41,600	32,403

Per Head per Annum.

	Weight in cwts.			Value in shillings.	
Fœces ..	0·78	0·50*	0·64	1·16	0·852
Urine ..	4·84	8·14	8·40	7·16	5·628
Total ..	5·62	8·64	9·04	8·32	6·480

Per Annum.

	Weight in tons.			Value per ton in shillings.	
Fœces ..	3,900	2,546	3,246	29·74	26·26
Urine ..	24,200	40,736	42,032	29·54	13·38
Total ..	28,100	43,282	45,278	29·68	14·31

The calculations of value are mine, and are based on the usual estimate established by the last sewage commission at 8s. 4d. per head per annum as obtained from the analyses of sewage. This was made up on the analyses of Messrs. Lawes and Gilbert, each individual contributing per annum in—

Urine	11·32 lbs. ammonia =	7s. 3d.
Fœces	1·64 lbs. ammonia =	1s. 2½d.
		8s. 5½d.

Taking Lieurnur's estimate of one cubic foot per head per annum solid, and 9 cubic feet liquid, rating also the relative value of 1 to 6, making 1s. 2d. per head for the former, and 7s. 2d. for the latter. Lieurnur's estimate allows a margin for loss.

I have calculated the values of Her Majesty's Commissioners' Report by taking the data in the table of the amounts of organic nitrogen and of phosphates, and valuing the former at £68 per ton, and the latter at £15 per ton, the values by which in the same report the manure of the A B C process is estimated.

The following shows the amounts in the table for 100,000 people:—

	Weight in cwts.			Per cent.		
	Organic nitrogen.	Potash.	Phosphates.	Organic nitrogen.	Potash.	Phosphates.
Fœces ..	957	649	1347	1·47	1·00	2·070
Urine ..	7531	2521	3380	0·89	0·30	0·402
Total	8488	3170	4727	0·937		0·522

It will be seen that the values given only allow 6s. 6d. per head per annum, or 14s. 4d. per ton. The value of the potash which I add to the table is, however, 3170 cwts. at 20s. = £3170, and makes the total value = £35,573, or 7s. 1d. (7·114) per head, or 15s 8d. per ton (15·68).

The magnesia and the other salts would no doubt bring up the value to the usual 8s. 4d., which, even at the high

* Parkes calculates the solid excreta of vegetarians at more than double this, or 12 ozs. per day.

quantities estimated, would give the manure an average value of 18s. 5d. per ton. The outside quantity to be removed, therefore, inclusive of all urine, cannot exceed 9 cwts. per head per annum, and its value cannot be less than 18s. per ton. Now, even at this high estimate the removal does not exceed that of the house-ashes. Taking the city through, for 500,000 inhabitants, the daily removal would be, at 300 days in the year (225,000 tons per annum), 750 tons. One high authority, Baron Liebig, estimates the annual value of the excreta per head (London sewage of 3,000,000 = £4,081,430) at 27s. 2d. This would make the excreta worth 60s. per ton. Even now, however, we find, where the earth system is thoroughly and efficiently carried out, Professor Corfield says the manure realises "above its possible value," and there can be no doubt whatever that if the profits of the farm are to be added, as in the case of the irrigators, the advantage would be enormously on the side of the dry system.

Taking however, the lowest computation, and putting the value of the excreta at 18s. per ton, every one must admit that it will pay to cart it away. X charcoal has a manurial value of £5 per ton, and an average composition—

Chloride of sodium*	4 × 1 =	4
Choride of potassium	8 × 10 =	80
Phosphate of lime	25 × 15 =	375
Carbonate of lime	5 × ½ =	2½
Carbonate of magnesia	5 × 5 =	25
Carbon	43 × 2 =	86
Silica	10 × ½ =	5
	100	577·5

(Equal to £5 15s. 6d. per ton.)

This manure contains all that is necessary for plants except nitrogen. The effect of mixing one ton of it with one ton average excreta, is to obtain when dry 25 cwts. of manure having nearly the above composition, with the addition of nitrogen = 6 per cent sulphate of ammonia, and worth £6 per ton. The total gain being 25 cwts. × 6 = £7 10s. = 30s. per ton of excreta added, *i.e*, my original estimate of its value. Of course this can be fortified by re-use, or by adding the ammonia obtained in the distillation, to almost any extent. In fact, one of the analyses quoted in my former paper shows a charcoal retaining nitrogen equal to 105 per cent of sulphate of ammonia. But in addition to its actual manurial value, by re-burning at any rate that portion of the product which is required to replenish the closets and keep up the supply for the city, I obtain some new products of value, which have never yet entered into the calculation. These are acetate of lime, tar, and gas. The former arises from the acetic acid which comes over from the destructive distillation of the vegetable residues ejected in excreta; the two latter mainly from the fat passed in the excreta. I have before shown that we are only employers of fat as we are employers of nitrogen and phosphates, and though a portion is consumed, especially in winter, in supplying fuel to our bodies, yet a large portion is found in the excreta. This appears as tar in the distillation. This little item in Glasgow would amount to seven tons a days. The acetate of lime is as valuable as the sulphate of ammonia.

I need not here go further into the chemistry of the process, as that has been fully investigated, so far as known products are concerned, and an exhaustive series of analyses of the results has been published in my former papers submitted to the Chemical Section of the British Association, and published in full in the CHEMICAL NEWS. The analyses speak for themselves, and the statements have never been refuted.

Now, with regard to the healthfulness of the dry process of removal, I can find no evidence of any kind which in the least tells against it. The germ theory of disease, now so generally believed in, is all in favour of a system which localises the poison and prevents its spreading. In opposition to water, which certainly spreads the germs, of that there is unlimited proof; the ordeal by fire to which I subject them must be absolutely destructive. No one knows exactly what the germs of cholera, scarlet fever, &c., are, but all admit them to be organic, and therefore all must admit that subjection to a red heat in an iron retort must destroy their vitality. Only last month, at a meeting of the London Association of Medical Officers of Health, Dr. Druitt, in his opening address, alluded to the prevalence of scarlet fever in London. "He believed scarlet fever to be emphatically a product of sewer gases." Dr. Rogers thought "scarlet fever to be more under control than any of the preventible diseases. The reason of its spreading so rapidly in some districts was that the excreta were not properly got rid of."

Dr. Tilley said that he had recently inspected forty or fifty houses into which there was a constant admission of sewer gases. (All this in London, where £5,000,000 have been spent on sewage with all the latest improvements, and gigantic pumps for lifting the sewage and leaving the gases behind.) Dr. Druitt said that sewers require disinfecting by drenching with carbolic acid in large quantity. Now, if it must be disinfected, how easy to add the disinfectant at the source.

I claim, then, the most extended benefit to health of towns by the adoption of this process.

As I propose, however, that the vault of a private house should only be emptied once a year, and as some may fear injury to health by allowing a ton or two of the X mixture to accumulate, I append an extract of a letter from W. Gilbert Hickey, Esq., C.E., of Calcutta, July 9, 1870, which should allay all fear on this head, and will show the extraordinary power of X charcoal. He says:—"I put this to a very crucial test. I placed an iron cylinder in my office, I perforated the bottom and placed a thin layer of charcoal poudrette, or poudrette coke, *i.e*., the residue left in the retort after carbonising excreta. I then sent to the public latrine, and had 1 cwt. of human ordure poured in. On top I placed a layer of poudrette coke, about two inches thick. It remained in the room for six weeks, and there was no nuisance of any kind."

Now, if 1 cwt. of human ordure can be kept in an office in Calcutta so long as this, completely deodorised by a slight layer of X charcoal, you may believe that nothing can be more inoffensive than a mixture of equal parts of each, such as I propose.

Now, as to the application to houses of the dry system, I deny that it requires any more supervision than the water-closet system.

One great advantage the householder has by using this process is, that if there should be any odour in his closet he has the remedy in his own hands. One of his servants has, perhaps, emptied some chamber slops into the urinal, without lifting the handle of the closet and allowing a charge of charcoal to fall. He has only to do this and the closet is at once deodorised. Now, with the water-closet, as the odour is due to sewer gas, the common method of letting down quantities of water only aggravates the evil, for the opening of the valve allows more gas to escape into the closet. For invalids the dry system is invaluable, and, in fact, absolutely necessary. I would request any who are not convinced of its value, or foresee any difficulty in applying it to towns, to read an American work on "Earth Sewage," by G. E. Waring, or inspect our arrangements at Dalmuir.

I understand that the householder is to have the use of the deodoriser for nothing, and the house to be visited by the "golden dustman," as I may call him, but once a year. The quantity of charcoal required being equal to that of the excreta removed. The method could be easily adopted to improve the removal of the town manure, with great advantage to health. The loss of Glasgow working men and women from ill-health and sickness must be

* Common salt itself an efficient disinfectant, always exists in X charcoal, but in variable quantity.

enormous, and the consequent loss of work of each person must be felt by the whole city in one form or other. Our town authorities are now, I believe, really awake to the alarming reports of the *Daily Mail* commissioner. I would quote, however, the best paragraph in Professor Corfield's report, and address them in the words of Mr. Rowe :—

"The man who in a crowded street is living in filth and breathing a putrid atmosphere, or who makes that street a receptacle for the offal which he casts from his dwelling, becomes an instrument of danger to his neighbour by spreading infection, and he not only hazards his own life but endangers that of others. The man who erects a flimsy edifice in a crowded thoroughfare, which in its falling may destroy life, should be prevented doing so, and he who constructs a house to let for profit, and pays no attention to those matters which are essential to comfort, but, on the contrary, so constructs it as to engender fever and endanger the lives of his tenants, all these are cases where, with propriety and in justice, the legislature ought to interfere, and to insist upon such a mode of construction as will not endanger human life."

ON FERMENTATION.*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from page 293.)

To return to our experiment. This glass vessel is now full of the gas, and by applying a taper which been lighted and blown out, but is still glowing, we shall find, on putting it into the jar, that it immediately ignites, which is the ordinary test of oxygen gas. By the aid of that theory, which has been discovered since the time of Liebig's suggestion, this one case of apparently anomalous action has been proved to be a perfectly normal and regular case of combination, and the same kind of thing has been done with regard to other cases of the same description.

A number of other processes which he classes with these may be shown to be due, not to any exceptional force that is at work in these cases, not to the force of any particular contagious action among chemical substances, but to the ordinary forces which induce chemical combination in the cases best known to us. Liebig's theory of contagious action has been alluded to, by a high authority in this country upon philosophical matters, as being a law of chemical action of a generality comparable to the law of gravitation in astronomy, and for that reason, if for no other, it must be of considerable importance to know what bearing our most advanced knowledge has upon that law. I dare say you see the connection between it and the case of fermentation. I will not go into particulars further than is necessary, in order to show you the general analogy.

First, I will take the case of alcoholic fermentation, as being the case best known. The ferment consists of little cells—which I hope I shall be able to show you at our next meeting—each one containing several chemical compounds, but itself a little living being. I will not say at present whether they are animals or plants. When you have these little organisms in water, or sugar, or in any moist substance, they are constantly, and of necessity, undergoing decomposition. You may arrest the decomposition by various agents, but if you do so, you kill them, or suspend their activity as yeast. No case is known to us of their acting like yeast without undergoing at the same time a process of chemical decomposition—being broken up into simpler substances than those which were contained in them. I pointed out, last week, that the sugar which is being decomposed by the yeast is by that process being broken up into substances which were contained in it, and that was what Liebig noticed. He said that this yeast is a substance which tends to decompose—it is breaking up into simpler substances, and it induces in these particles of sugar which are in contact with it a decomposition similar to its own. The action which it is undergoing is contagious, and passes over to the contiguous particles of sugar; and he adduced cases like that of oxygen, as affording analogies among simple well-known bodies. I think what I have said with regard to the case of oxygen will be sufficient to show you that in those simple cases the idea of contagion is certainly not applicable.

A foreigner, who was describing some time ago the luxuriance of the crops in America, spoke of a bushel of *mice* being sown in a field, and a hundred bushels of *mice* being reaped. Of course, what he meant to say was *maize*, or Indian corn; but I am reminded of that anecdote by the necessity I am under for a moment of asking you to consider for a while some living beings under their general functions only. Suppose you had a bushel of actual English mice, and you put them into a granary full of corn. There clearly would soon be a great change. You are supposed to know nothing more about the particular organisation of these little beings than you know about the particular organisation of the little yeast cells. You know that these little things eat grain, and that in place of the grain which they eat there appear various products of decomposition, which can be easily collected and examined. They give off carbonic acid, and so forth, and if you examined the state of that granary after a time, you will find a chemical change, or rather a set of chemical changes, going on in the organisms of these mice. The substance of which they consist would be actually wasting away; they would be giving off carbonic acid, and nitrogenous and other products. And if you also examined the state of the corn which was there at first, you would find that it finally passed over into these same products; and I say that the theory of contagious action is as much applicable to the action of the bushel of mice in the granary full of wheat, as to the action of the yeast cells upon a solution of sugar. There is, in the one case, as in the other, an assimilation by the living organism of the material upon which it acts. The materials undergo certain changes, of which the general results are known to us, but of which the particulars are, I may say, in the main almost completely unknown. As to the processes by which these products are formed, it is as well to say that we do not know them. We know a little here and there about them, but it is nothing compared to our ignorance; therefore the resemblance is the more striking, and if we were to believe in the contagiousness of chemical action as applied to the case of the assimilation of sugar, by a ferment, and say the ferment gives off alcohol and carbonic acid, and that sugar is also resolved into alcohol and carbonic acid, we should really be describing in its general features a process analogous to that which I have just now mentioned; such a general analogy would be readily admitted by those who go into the particulars of the process, but I think it is of particular importance to have in addition to it something more practically useful to guide us in understanding chemical reactions. For that purpose I will take one or two chemical reactions of an exceedingly common kind. For instance, I will again take that chromic acid solution which I just now employed. Here you see is the green residue which I told you would be produced; I again take some of this chromic solution, throw some of it into water in this jar, so as to visibly tinge the water red; I will slightly acidulate the liquid by oil of vitriol, and I will then pour into the mixture (which I will describe as chromic acid dissolved in water, for the potash which was present is taken away from the compound by the sulphuric acid), a substance which I will merely describe as being greedy of oxygen, sulphurous acid. If Liebig's theory of contagious action were generally true in chemical action, you would, no doubt, expect that this sulphurous acid, in taking up oxygen, would make the chromic acid also take up oxygen. It is quite possible for the chromic acid to do so, for that

* The Cantor Lectures. Delivered before the Society of Arts.

blue substance which we had in this jar at first was nothing but chromic acid with oxygen added to it. But instead of this, we shall have at once a reduction of the chromic acid to deep green, which I dare say appears to you almost black. It is precisely the same thing as that pale, dirty green which you saw before, but in its concentrated state. There is no oxygen taken up by the chromic acid, but it at once loses oxygen. This sulphurous acid wanted to combine with oxygen, and it tore away at once some of the oxygen from the chromic acid, and there was in this chromic acid a process, not similar to that which the sulphurous acid underwent, but a process precisely opposite to it—one combined with oxygen, while the other lost oxygen—and if you examined the liquid, you would find that the sulphurous acid which took part in the process, and has taken up oxygen, is now in the form of sulphuric acid. Again, I have here some granulated zinc, which will very easily evolve hydrogen, particularly when its activity is stiumlated by throwing a little copper vitriol on to it. After adding a little water, I will throw in a little oil of vitriol, so as to get an evolution of gas. Then I have here a solution which I think must look black to you, except at the edges, which is a solution of a beautiful salt called permanganate. It is used for deodorising certain fetid waters, and I might compare it to the chromate I was using just now. It consists of an acid of the metal manganese. If I throw some of that into the mixture which I have just prepared, and leave it for a short time, and then examine it, we shall find that, instead of being induced to give off hydrogen like the other body, which is doing so vigorously, we shall find it will do the opposite, and will combine with hydrogen; and the colour which belongs to it, and which can be recognised so easily, will disappear, because hydrogen will be taken up by its oxygen, and it will be reduced and brought down to a substance containing comparatively little oxygen. There, again, as in the previous case of the chromic acid, we find that there is a kind of chemical polarity in the general mode of action, that the one substance acted upon does precisely the opposite of the other. There is no tendency in this case to do the same thing, but the two substances acting upon one another do precisely the opposite, the one taking up what the other loses. Not only is that the case in the instance of the action which I have mentioned here, but in a great number of other cases of considerable interest and importance—bodies which act chemically with considerable energy when allowed to do so, are prevented by others from so doing when those others are trying to do the same thing. If, for example, we put metallic copper into nitric acid, the copper would dissolve with immense energy; it would undergo what I might call a process of combustion. Again, if I put mercury in contact with the acid, the same thing would occur; it would be dissolved almost as rapidly as the copper. But if I put the two together into nitric acid, the copper prevents the mercury from undergoing combustion; and so far from encouraging it to do the same thing, it actually takes from it the power which it possessed before of undergoing a combination of that kind. And more than that, if I take mercury which has been burned—a solution of mercury in the form of corrosive sublimate—and put copper into it, the copper will actually unburn it, or make it come back again from the point at which it had got, and throw down the metal. You can see the process which takes place; on putting a strip of clean red copper into the solution it becomes grey, and throws down the mercury from the solution. So far from encouraging the mercury to oxidation, it makes it do the opposite to that which it otherwise had a tendency to do.

Again, I will take some of this solution of copper—it ought to be some of the very solution which is being made here, where copper is being dissolved at the expense of mercury—and if I put into it a piece of common iron, perfectly clean and white, it will very speedily combine; and I cannot express its functions in combining better than by saying that it will make copper uncombine, for the copper which was burnt is now being unburnt.

If we go carefully, with the knowledge of their particulars, through the best known chemical processes, we find that there is, as a rule, a force at work which I might describe as polarity—a tendency among contiguous particles which are acting on one another to assume functions which can be best characterised as being opposite to one another. Whatever the one is doing, the other is doing as nearly as possible the very opposite of it, and any tendency to do like work I know not of. There are, however, cases which would appear to be favourable to the notion of contagious chemical action. If I blow out that gas-burner, still letting the gas escape, and then bring near to it a burning splint, it will set fire to the gas, and the same with a candle-wick if I bring close to it a burning match—the match, which is burning, communicates to the wick the process which it is undergoing—but the explanation is this, it does so merely because of the high temperature which it has attained. If by any other process, such as concentrating the rays of a powerfully-heated surface by means of a lens, I raise the temperature of the gas to that point at which it is capable of combining with the oxygen of the air, it will do just as well. The accident that the high temperature is communicated by the burning splint has nothing to do with the process.

There is one other remarkable instance which I must give you, to show you the difficulty in some cases of analysing these phenomena. It is the case of the metal platinum, which I can hardly describe better in general terms, as regards its properties, than by comparing it to gold. It is what is termed a noble metal; it does not dissolve in any ordinary acid; you might boil platinum in nitric acid for any length of time and it would not dissolve. On the other hand, silver is a metal which dissolves readily in this acid, and if you melt silver and put platinum into it, it will also melt, and you obtain a compound of the two metals mixed pretty uniformly together. It was noticed that when such a button of platinum and silver is put into nitric acid, not only does the silver itself dissolve, as you would expect, but some of the platinum also dissolves with it; not the whole, but a portion. That seems, at first sight, favourable to the theory of contagion; it seems natural to suppose that the silver in dissolving has commnnicated the same tendency to the platinum, and made some of it dissolve. But that explanation will not do, and for this reason. When platinum is combined with anything else, I care not what, its properties are not the same as when uncombined. The very essence of chemical combination is that the particles which are in intimate contact unite, and that the compound possesses different properties from the original elements. We know that metals combine with one another; there are many cases known to us of the forcible union of metals, and we have no right to suppose in any case, unless we have actual proof of it, that a metal is present in such a compound with its ordinary properties. Therefore, it is not free platinum, but a compound of platinum and silver which dissolves, and there are some compounds of platinum which dissolve in water, and others which dissolve in nitric acid, so that this process has really nothing to do with contagious action.

(To be continued).

London Institution.—At a meeting of the Board of Management of this Institution on Wednesday, Dr Henry E. Armstrong was appointed Professor of Chemistry, an office once held by Mr. W. R. Grove, Q.C., and subsequently by Mr. J. Alfred Wanklyn. Dr. Armstrong studied chemistry under Professors Hofmann, Frankland, and Kolbe, and has been associated with Dr. Frankland and the late Dr. Matthiessen in original researches. We understand that classes for Practical Chemistry will be formed at this Institution early in the new year.

CHEMICAL TABLES ACCORDING TO THE THEORIES OF MODERN CHEMISTRY.*

By Professor ALBERT R. LEEDS.

(Continued from p. 242.)

TABLE II.—ATOMIC WEIGHTS ACCORDING TO THE MOST IMPORTANT WORKS UPON CHEMISTRY.
H = 1. Rammelsberg has O = 100.

Element.	Ancient Chemistry.					Transition.	Modern.		
	Graham.	Miller.	Gmelin.	Rammelsberg.	Fresenius.	Watts.	Williamson.	Wurtz.	Cooke.
Aluminum	13·69	13·70	13·7	171·0	13·75	13·75	27·5	27·0	27·40
Antimony	129·03	12·20	129·0	1504·0	122·00	120·30	122·0	122·0	122·00
Arsenic	76·00	75·00	75·2	940·0	75·00	75·00	75·0	75·0	75·00
Barium	68·64	68·50	68·6	857·0	68·60	68·60	137·0	137·0	137·00
Bismuth	70·95	210·30	106·4	2600·0	208·00	210·00	210·0	210·0	210·00
Boron	10·90	10·90	10·8	136·2	11·00	11·00	11·0	11·0	11·00
Bromine	78·26	80·00	78·4	1000·0	80·00	80·00	80·0	80·0	80·00
Cadmium	55·74	56·00	55·8	696·8	56·00	56·00	112·0	112·0	112·00
Cæsium	—	—	—	—	133·00	—	133·0	—	133·00
Calcium	20·00	20·00	20·5	250·0	20·00	20.00	40·0	40·0	40·00
Carbon	6·00	6·00	6·0	75·0	6·00	12·00	12·0	12·0	12·00
Cerium	46·00	46·00	46·3	575·0	—	46·00	92·0	—	92·00
Chlorine	35·50	35·50	35·4	443·3	35·46	35·50	35·5	35·5	35·50
Chromium	28·15	26·30	28·1	329·0	26·24	26·20	52·5	53·5	52·20
Cobalt	29·52	29·50	29·6	375·0	29·50	29·50	58·5	59·0	58·80
Columbium	—	48·80	—	611·0	—	97·60	195·0	—	94·00
Copper	31·66	31·70	31·8	396·6	31·70	31·70	63·5	63·5	63·40
Didymium	49·60	48·00	—	—	—	48·00	96·0	—	95·00
Erbium	—	—	—	—	—	—	—	—	112·60
Fluorine	18·70	19·00	18·7	237·5	19·00	19·00	19·0	19·0	19·00
Glucinum	26·50	4·70	17·7	86·5	—	4·70	9·0	—	9·30
Gold	98·33	196·60	199·0	2458·0	196·00	196·00	196·0	197·0	197·00
Hydrogen	1·00	1·00	1·0	12·5	1·00	1·00	1·0	1·0	1·00
Indium	—	—	—	—	—	—	74·0	—	72·00
Iodine	126·36	127·00	126·0	1586·0	—	127·00	127·0	127·0	127·00
Iridium	98·68	98·60	98·7	1232·0	127·00	98·60	197·0	198·0	196·00
Iron	28·00	28·00	27·2	350·0	—	28·00	56·0	56·0	56·00
Lanthanum	48·00	46·00	36·1	580·0	28·00	46·00	92·0	—	93·60
Lead	103·56	103·60	103·8	1294·6	—	103·60	207·0	207·0	207·00
Lithium	6·43	7·00	6·4	82·5	103·50	67·00	7·0	7·0	7·00
Magnesium	12·67	12·16	12·7	150·0	12·00	12·00	24·0	24·0	24·00
Manganese	27·67	27·50	27·6	337·5	27·50	27·60	55·0	55·0	55·00
Mercury	100·07	100·00	101·4	1250·0	100·00	100·00	200·0	200·0	200·00
Molybdenum	47·88	48·00	48·0	575·0	46·00	46·00	96·0	96·0	96·00
Nickel	29·57	29·50	29·6	362·5	29·50	29·00	58·5	59·0	58·80
Nitrogen	14·00	14·00	14·0	175·0	14·00	14·00	14·0	14·0	14·00
Osmium	99·56	99·40	99·6	1250·0	—	100·00	199·0	199·2	199·20
Oxygen	8·00	8·00	8·0	100·0	8·00	16·00	16·0	16·0	16·00
Palladium	53·27	53·20	53·4	664·0	53·00	53·00	106·5	106·6	106·60
Phosphorus	32·02	31·00	31·4	387·5	31·00	31·00	31·0	31·0	31·00
Platinum	98·68	98·60	98·7	1237·5	98·94	99·00	197·0	197·5	197·40
Potassium	39·00	39·00	39·2	489·0	39·11	39·00	39·0	39·1	39·10
Rhodium	52·11	53·20	52·1	650·0	—	52·00	104·0	104·4	104·40
Rubidium	—	—	—	—	85·40	—	85·0	—	85·40
Ruthenium	52·11	53·00	51·7	650·0	—	52·00	104·0	104·4	104·40
Selenium	39·57	39·70	40·0	495·3	39·50	79·00	79·5	79·5	79·40
Silicon	21·35	14·00	14·8	185·0	14·00	28·00	28·0	28·0	28·00
Silver	108·00	108·00	108·1	1350·0	107·97	108·00	108·0	108·0	108·00
Sodium	22·97	23·00	23·2	287·5	23·00	23·00	23·0	23·0	23·00
Strontium	43·84	43·80	44·0	548·0	43·75	43·80	87·5	87·5	87·60
Sulphur	16·00	16·00	16·0	200·0	16·00	32·00	32·0	32·0	32·00
Tantalum	92·30	68·80	185·0	860·0	—	37·60	138·0	—	182·00
Tellurium	66·14	64·50	64·0	802·0	—	128·00	—	129·0	128·00
Terbium	—	—	—	—	—	—	—	—	—
Thallium	—	—	—	—	203·00	—	203·0	—	204·00
Thorium	59·59	59·50	59·6	744·0	—	59·50	238·0	—	231·40
Tin	58·82	59·00	59·0	735·3	59·00	116·00	118·0	118·0	118·00
Titanium	24·29	25·00	24·5	300·0	25·00	50·00	50·0	50·0	50·00
Tungsten	94·64	92·00	95·0	1150·0	—	92·00	184·0	184·0	184·00
Uranium	60·00	60·00	217·0	743·0	59·40	60·00	120·0	120·0	120·00
Vanadium	68·55	68·50	68·6	856·8	—	68·50	137·0	68·6	51·37
Yttrium	32·20	—	32·2	437·5	—	—	64·0	—	61·70
Zinc	32·52	32·60	32·2	406·6	32·53	32·50	65·0	65·2	65·20
Zirconium	33·62	33·60	22·4	558·5	—	33·50	89·5	89·6	89·60

* Communicated by the Editors of the *Journal of the Franklin Institute*. From advance-sheets.

ON A METHOD FOR THE DETERMINATION OF SULPHUR IN COAL GAS.*

By A. VERNON HARCOURT, M.A., F.R.S., Sec. C.S.

THE apparatus on the table represents the result of a number of experiments on the determination of sulphur in coal gas, and provides, I believe, a means of making this determination easily and accurately.

But since its completion a new method of determining sulphur has been published and brought into use by the gas referees, and as this method is certainly superior in simplicity, and may be superior in other respects to that which I have devised, I feel some hesitation in laying any claim to the attention of the Section. However, the problem to be solved is one of so much difficulty and so much importance, that I will venture to describe very briefly the process which is here in operation.

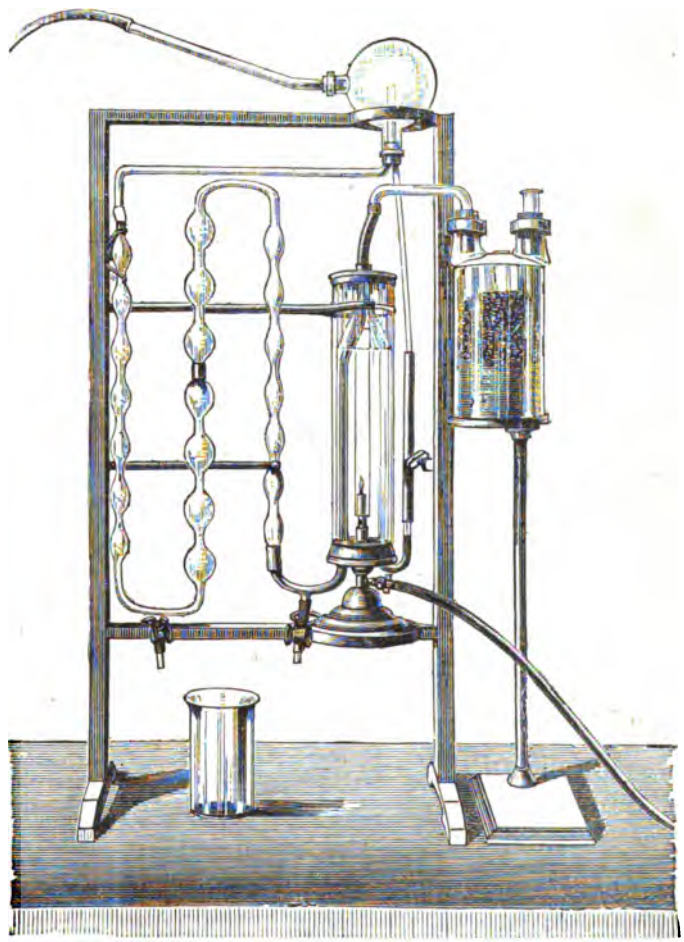
Some difference of opinion exists as to the statement of the problem. Do we desire to know the total amount of sulphur in the gas analysed, or the amount which is converted into sulphur acids when a jet of gas is burned in the air? On the one hand, the practical object being to ascertain the injury to which we are liable from gas burned in the ordinary way, and the only sulphur compounds formed by burning gas, which are known to be injurious, being the sulphur acids, a method in which the acids formed by a jet of gas burning in the air are determined appears the most appropriate. On the other hand, we can hardly expect to arrive at definite and concordant results, except by determining the total amount of sulphur, since the part, if any, that commonly escapes unburnt, is likely to vary with the burner employed. I believe, however, that it will be found that this distinction is not a very real one, but that in a jet of gas which is well supplied with air, $\frac{99}{100}$ths of the sulphur is oxidised.

In my apparatus I use a small Bunsen's burner, which gives a flame, scarcely visible in the daylight, of three-quarters of an inch in length when burning at the rate of a quarter of a cubic foot per hour. The gas is supplied by means of an aspirator with between 20 and 30 times its volume of air. A funnel placed at the top of the cylinder in which the gas burns admits the air through holes in its neck and distributes it down the sides of the cylinder, while the products of combustion and the excess of heated air are withdrawn from within the funnel through a tube rising from the bottom of the cylinder. This tube fits loosely into another tube, which passes through an india-rubber plug closing the cylinder, and is attached to a system of bulbs, through which are driven the air in which the gas has burned, and the liquid used to wash it. From the bulbs they pass into a two-necked receiver placed over the cylinder, whence the air escapes into the aspirator, while the liquid descends through a small tube to the bottom of the cylinder and repeats its course.

The liquid is an ammoniacal solution of copper. The ammonia serves, as is well known, to aid in fixing the sulphur compounds, while the copper determines, in presence of the excess of air, the oxidation of sulphite to sulphate. The activity of copper in this respect may readily be proved by pouring into each of two large bottles a few drops of ammonia and of sulphurous acid, and adding, in one case, a drop of a solution of any copper salt. After shaking both bottles for a minute or two to bring the liquid and air contained in them into contact, if some dilute sulphuric acid is poured into each, and then some solution of iodide, it will be found that in one case plenty of sulphurous acid remains, but that in the other, when the drop of copper solution was added, all has disappeared.

When coal gas burns, the greater part of its sulphur seems to be oxidised completely to sulphuric acid, but a part of it only to sulphurous acid, and it may well happen that some of this sulphurous acid, after being arrested by the ammonia, may be disengaged again by the great excess of carbonic acid by which it is accompanied, and may finally escape from the solution. Once converted into sulphate it is safe.

The air which enters the cylinder has passed first through a large Woolfe's bottle containing pumice and ammoniacal solution of copper, the latter rising three or four



inches from the bottom of the bottle, the former to the top. Before each experiment 50 c.c. of strong ammonia is poured into the bottle. This arrangement serves to keep up the supply of ammonia in the apparatus, and to purify the air from traces of sulphurous acid or sulphuretted hydrogen. To trust to the purity of the air, even in rooms which are not chemical laboratories, appears to be very hazardous, when we consider that the volume passing through the apparatus in each experiment is 50 cubic feet, or more, and that 1-50th of a grain of sulphur

* Read before the British Association. Reprinted, by permission, from the *Journal of Gaslighting*.

salicyl. The bromine in the bromocoumarin obtained from these bodies by means of acetic anhydride is not attacked by boiling with potash. In the *a* series the Br or Cl must be connected with the carbon of what may be called the acetic residue. The bodies of this series are easily decomposed with alkalies. In *a* dibromocoumarin one-half of the Br appears to be in union with the C_6 group, and the other with the acetic residue. *a* bromo- and chlorocoumarin, from their yielding with alkalies coumarilic acid, seem to be bromides and chlorides of an acid radicle (coumarilyl). But the ammonic coumarilate on boiling with potash does not give the acid. It may, therefore, be that coumarilic acid is not a true acid containing the group COHO, but is only coumarin with one of its H replaced by HO.

Fittig and others consider coumarin as the glycollide of oxycinnamic acid. If this were the case it certainly would be an anomalous one, as it may be kept dissolved in caustic alkali for months without formation of appreciable quantities of coumaric acid; neither does it form an amide when treated with gaseous ammonia. Whereas, the corresponding glycollide of salicylic acid is converted into a salicylate as quickly as it dissolves in an alkali.

The next communication was by Dr. Debus, "*On the Formula of Glyoxylic Acid.*"

Dr. Debus showed that this acid ought to be written $C_2H_2O_3$, and not $C_2H_4O_4$. He considers it in reality to be the aldehyde of oxalic acid. Among other reasons for this view he quoted its behaviour towards bisulphites. Dr. Odling was of the same opinion. He sees the aldehydic character of glyoxylic acid in its property of easily combining with an atom of water, or of ammonia, or of ethyl, &c. Mr. Perkin thinks the second formula the right one. Among other evidences for the correctness of this view, he mentioned the fact that glyoxylic acid, when treated with phosphoric pentabromide, takes up three atoms of bromine in the place of three of hydroxyl, thus:—

$$\left.\begin{matrix}\mathrm{COHO}\\ |\\ \mathrm{C}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{HO}\\ \mathrm{HO}\end{matrix}\right.\end{matrix}\right\}+3\mathrm{PBr_5}=\left\{\begin{matrix}\mathrm{COBr}\\ |\\ \mathrm{C}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{Br}\\ \mathrm{Br}\end{matrix}\right.\end{matrix}\right\}+3\mathrm{PBr_3O}+3\mathrm{HBr}.$$

Were glyoxylic acid constituted as represented by Dr. Debus, then, argued Mr. Perkin, there was every reason to believe that when acted upon by phosphoric pentabromide it would be entirely broken up, thus:—

$$\left.\begin{matrix}\mathrm{COHO}\\ |\\ \mathrm{COH}\end{matrix}\right\}+\mathrm{PBr_5}=2\mathrm{CO}+2\mathrm{HBr}+\mathrm{PBr_3O}.$$

CORRESPONDENCE.

MAGNETIC POWER OF A BATTERY.

To the Editor of the Chemical News.

Sir,—In your "Correspondence" of Chemical News, vol. xxii., p. 272, allusion is made to the statement in text-books of electricity that the intensity of the current is greatest when the external resistance is equal to the internal. As a proof is not usually given, the following, which I think will be found satisfactory, may be of use to some of your student-readers. Suppose we have *m* cells, the electromotive force of each being E, and the internal resistance of each being R. Suppose the cells are so distributed that we have *x* rows, each row consisting of *y* cells, in each of the rows the positive elements being connected one with another, and also the negative elements being connected one with another. If, then, the external resistance be *r*, and the intensity of the current I, we have, by Ohm's law,—

$$\mathrm{I}=\frac{x\mathrm{E}}{\frac{x\mathrm{R}}{y}+r}$$

Also, $x.y=m$. Differentiate with respect to x, and we get—

$$\frac{d\mathrm{I}}{dx}=\frac{\mathrm{E}r+\frac{x^2\,dy\mathrm{ER}}{y^2\,dx}}{\left(\frac{x\mathrm{R}}{y}+r\right)^2}$$

For a maximum or minimum value of I, the condition is—

$$\mathrm{E}r+\frac{x^2\,dy\mathrm{ER}}{y^2\,dx}=0$$

Substituting for $\frac{dy}{dx}$ its value $-\frac{y}{x}$, we get as the condition

$$r=\frac{x\mathrm{R}}{y}$$

That is, the external resistance is equal to the internal. If we differentiate again, we obtain—

$$\frac{d^2\mathrm{I}}{dx^2}=\frac{\frac{\mathrm{ER}}{y}\left(\frac{x\,dy}{y\,dx}-1\right)\left(3r-\frac{x\mathrm{R}}{y}\right)}{\left(\frac{x\mathrm{R}}{y}+r\right)^3}$$

Substituting for $\frac{dy}{dx}$ its value $-\frac{y}{x}$

$$\frac{d^2\mathrm{I}}{dx^2}=-\frac{\frac{2\mathrm{ER}}{y}\left(3r-\frac{x\mathrm{R}}{y}\right)}{\left(\frac{x\mathrm{R}}{y}+r\right)^3}$$

Suppose, now, that $\frac{x\mathrm{R}}{y}=r$; and the expression becomes—

$$\frac{-\frac{4\mathrm{ER}r}{y}}{\left(\frac{x\mathrm{R}}{y}+r\right)^3}$$

That is, when the external resistance is made equal to the internal, the value of $\frac{d^2\mathrm{I}}{dx^2}$ is negative, which shows that under this condition the value of I is a maximum.—I am, &c.,

James Bottomley.

Queenwood College, near Stockbridge, Hants, Dec. 8, 1870.

CHEMICAL PROBLEMS.

To the Editor of the Chemical News.

Sir,—I observe in your review of Professor Thorpe's work on "Chemical Problems" a slight inaccuracy, which I hope you will allow me to point out. You state you "believe that Dr. Roscoe was one of the first to recognise the value of such questions." I, on the contrary, believe that I was *the first* to introduce them. In 1851 the first edition of my "First Step" appeared, which was the first work, as far as I am aware, devoted to chemical problems, and I had for some years before the publication of it employed the problems in my classes. When I had the work ready for the press I sent a copy of the arithmetical questions to my friend Dr. Frankland, who was then Professor of Chemistry at Owen's College, and he wrote to ask my permission to make use of them in his classes before the work was published, which I readily granted, and he and Dr. Lyon Playfair were the first to employ them after its publication. In my "Second Step," which appeared in 1863, which is prior to the publication of Dr. Roscoe's "Chemistry," I gave an advanced course of chemical problems.

It has been a pleasure to me to see the problems so extensively employed, as I believe they have effected some improvement in chemical examinations, and I hope the new class of questions I have given in the last edition of my "Qualitative Analysis" will be adopted, as I believe they would put a stop to the cramming system, which is

now unfortunately so prevalent, and which is so ruinous to all real mental culture.

But the examinations in practical chemistry are, I think, in a far worse position at the present time than the written examinations, and I think if you would allow an interchange of opinions through the columns of the CHEMICAL NEWS on this subject, it would conduce very much to the progress of the science. I will, with your permission, commence this interchange in another communication.—I am, &c.,

ROBERT GALLOWAY.

Royal College of Science, Dublin,
December 19, 1870.

THE REACTION BETWEEN WATER AND NITROGEN TETROXIDE.

To the Editor of the Chemical News.

SIR,—From Mr. Vernon Harcourt's letter, which appeared in the CHEMICAL NEWS, vol. xxii., p. 286., it seems that that gentleman does not raise any objection to the validity of the method of determining nitric oxide employed in my recent investigation.

The exact nature of the chemical changes occurring during the mutual action of water, nitric oxide, and excess of oxygen, was never the subject of any special theory on my part. On the contrary, I accepted all the various equations given in the text-books, and showed that, no matter which be adopted, the ultimate result is the same in all cases, viz., nitric acid.—I am, &c.,

ERNEST T. CHAPMAN.

11, Sutherland Gardens, Harrow Road.
December 15, 1870.

ACTION OF ZINC ETHYL.

To the Editor of the Chemical News.

SIR,—In the last number of the CHEMICAL NEWS, I find a short note on the "Action of Zinc Ethyl Upon Phosphuretted Hydrogen," by C. Schultz-Sellack. Allow me to state that, experimenting on the same subject several years ago, Dr. Drechsel and myself found that, contrary to Mr. S.-S.'s statement, zinc phosphine, ZnHP, or $Zn_2H_2P_2$, is readily formed, provided the ethereal solution of the zinc-ethyl be kept cold by a freezing mixture. The zinc phosphine is a perfectly white and amorphous powder, and is converted by the action of iodide of ethyl into Hofmann's well-known double compound of iodide of triethylphosphine and iodide of zinc. We never published the results of our investigation, and I cannot now give analytical data, but our analyses of the zinc phosphine, as well as of the ethylated double compound, agreed perfectly well with the formulæ.—I am, &c.,

B. FINKELSTEIN.

Hebburn, Gateshead-on-Tyne,
December 17, 1870.

MISCELLANEOUS.

Letts's Diaries for 1871.—We have received specimens of some of the diaries issued by this well-known firm. The Medical, Monthly, or Professional, and Appointment Diaries are exceedingly well arranged, and contain a large amount of valuable information. They will prove of great service to members of the various professions, &c.

Beer Brewed from Rice.—A. Metz.—It appears that the brewing of beer from rice has already assumed large proportions in some parts of Germany. The author has analysed a variety of this beer brewed at Weisenau, near Mayence, from a mixture of ⅔ of malt and ⅓ of rice. The beer thus produced is very clear, of a pale colour; the colorimetrical test, according to M. Leyser's method, gave as result that the colour of this beer was equal to that of a mixture of 100 c.c. of water and 1·2 c.c. of decimal normal iodine solution, while the colour of the Münich beers average from 3 to 3·5 and even 4·9 c.c. of the iodine solution alluded to in 100 c.c. of water. The taste of the rice beer is extremely pleasant, very mild; it foamed strongly yet retained its carbonic acid well. Specific gravity = 1·0238. The beer contained, in 100 parts—Alcohol, 3·65; sugar, 1·63; dextrin, 5·13; protein compounds, 0 37; mineral matter, including 0·0775 phosphoric acid, 0·22; loss, 00·1; total quantity of extract, 7·36 per cent, being made up, in 100 parts, of—Sugar, 22·15; dextrin, 69·70; protein compounds, 5·03; ash (including 1·05 of phosphoric acid), 2·99. In order to give a more correct view of the value of this rice beer, as compared with other beers, the author quotes the following average percentage results of analysis of twenty-one varieties of Bavarian beers recently analysed by Dr. C. Prandtl:—

	Rice beer.	Münich beers.		
		Average.	Maximum.	Minimum.
Alcohol	3·65	3·55	3·98	3·23
Total extract ..	7·36	6·17	6·61	5·42
Sugar	1·63	1·08	1·38	0·82

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Polytechnisches Journal von Dingler, first number for November, 1870.

This number contains the following original papers and essays relating to chemistry and allied sciences:—

Suggestions for the Construction of a New and Improved Bathometer.—Dr. H. Emsmann.—A bathometer is an instrument for sounding great depths at sea. The details of this paper cannot be well understood without the aid of the engravings which illustrate it.

Estimation of the Total Quantity of Carbon Contained in Iron.—Dr. Wittstein.—The author first states that the method suggested for the estimation of carbon in iron (crude cast-iron) by the late M. Berzelius, is the best and most simple. It consists in treating the iron with chloride of copper. The author's experiments with this method were conducted as follows:—1·25 grms. of coarsely pulverised iron were added to a liquid contained in a flask, and consisting of 50 grms. of water, 10 grms. of chloride of sodium, and 10 grms. of sulphate of copper. The iron was left in this solution for a couple of days. Ten grms. of hydrochloric acid, sp. gr. 1·13, were then added. The flask was next heated on a sand-bath. By this operation the hydrated oxide of iron and the finely divided metallic copper were dissolved, and after the liquid had been diluted with about twice its bulk of water, the carbonaceous matter was collected on a previously weighed filter, and dried at 100°. The quantity obtained weighed 0·097 grm., losing by ignition a quantity of 0·042 grm., which amounts to 3·36 per cent of carbon. The residue of the ignition was tested for the presence of iron and copper by dissolving it in nitro-hydrochloric acid (*aqua regia*). Both metals, to the amount of 1 centigrm., were found to be present; the remaining silica was still found to contain a small quantity of carbon.

Testing of Graphite.—F. Stolba.—The author states that the ignition of graphite (previously well dried) may be readily performed in a platinum crucible, the lid of which is perforated with a hole of some 5 m.m. diameter. The lid is placed on the crucible in such a manner as to leave about one-fourth of its opening uncovered; the consequence of this arrangement is that a strong draught of air is caused in the crucible, whereby the combustion of the graphite is greatly accelerated and the combustion completed (supposing 0·5 grm. of substance to have been taken) in about four hours' time over a good Bunsen burner. The introduction of oxygen gas into the crucible is, according to the author, rather a disadvantage, as it often causes the fusion of the ash, and hence the withdrawal of carbonaceous particles from the oxidising action of the gas.

Progress Made in the Desilverising of Lead by Means of Zinc at the Royal Prussian Lead-Silver Smelting Works.—Dr. Wedding and Dr. Brünning.

Best Method of Extracting Indium from Zinc-blende (native Sulphuret of Zinc).—F. Stolba.—The author first pulverises the zinc-blende and next mixes that powder with about 10 per cent of its weight of burnt gypsum. This mass is made into a paste with water, and formed into round cakes of about three-quarters of an inch thickness, and from four to five inches diameter. Through these cakes holes are bored of about one-sixteenth inch diameter, and one and a-half inches apart. After drying, the cakes are ignited in a strong coal or coke fire; after thorough ignition the material is ground to powder, and treated with hydrochloric or sulphuric acid, and the indium precipitated from the acid solution, while boiling in a copper kettle, by means of zinc.

Testing for Cæsium as Double Chloride of Tin and Cæsium.—F. Stolba.—This paper contains an exhaustive account of an analysis of lepidolite from Rozna (Austria). The chief point of interest in reference to the preparation of the double salt alluded to, is that ammonia should be rigorously excluded from the materials, because the ammonium stannochloride is as insoluble in concentrated hydrochloric acid as the cæsium stannochloride.

Use of Peat as Fuel Mixed with Coals.—Dr. Dingler.—This Paper treats on the best plan of utilising peat mixed with coal for the purposes of steam-boiler and other furnaces.

Reduction of Tellurous Oxide by Grape Sugar.—F. Stolba.—The author, states that when tellurous oxide, dissolved in excess of potassa or soda solution, is heated along with grape sugar. the result is the precipitation of metallic tellurium in finely divided state.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1870.

Nitration of β Naphthol.—O. Wallach and H. Wichelhaus.—In the introduction to this paper the authors briefly refer to a method of nitration invented by the late Dr. Bolley, and applicable to such bodies as resist the ordinary processes used for this purpose. This new process has been applied by the authors to the nitration of β naphthol previously obtained free from any α naphthol, the result being the formation of binotronaphthol, $C_{10}H_5(NO_2)_2(OH)\beta$. This substance crystallises in small needle-shaped crystals, fuses at 195°, is very difficultly soluble in water even if boiling, but more readily so in alcohol, and very readily in ether and chloroform; these solutions exhibit an intense yellow colour. The β nitro-napthhol does not form salts so readily as the α compound analogous to it.

Acetyl Derivatives of Ammonia.—H. Wichelhaus.—The first portion of this paper contains a lengthy series of complicated formulæ, exhibited for the purpose of showing how triacetamide might be formed. The author next states that he has succeeded in obtaining that body by heating together acetonitrile and acetic acid to a temperature of 200°. The substance thus prepared is a solid, crystalline form, fusing at 79°. The larger portion of this paper is devoted to theoretical discussions on reactions which might be called into play. Triacetamide is neutral in its behaviour with test paper while in solution; diacetamide tinges blue litmus paper red.

Preliminary Notice.—C. Huber.—The author states that the body obtained by him some three years ago by the action of bichromate of potassa and sulphuric acid upon nicotine, viz., the acid $C_6H_5NO_8$, is not, as has been formerly announced by him, an amido-acid, but pyridine carbonic acid.

On Nitro-chlorphenol.—T. Petersen.— This extensive essay, illustrated by several crystallographical diagrams, is divided into the following sections:— Mononitro-monochlorphenol, dinitro-monochlorphenol, trichlornitrophenol, and trichlordinitrophenol.

On Yttrocerite.—Dr. C. Rammelsberg.—After briefly referring to the labours of the late Dr. Berzelius on this mineral, which occurs near Fahlun (Sweden), the author states that, having recently analysed this mineral, he found it to consist of, in 100 parts—Lime, 47·27; oxide of cerium, 9·35; yttria, 14·87; loss by ignition, 2·52; the remainder being fluorine. The formula of this substance is—

$$2\left\{\begin{matrix}CeFl_3\\2YFl_3\\9CaFl_2\end{matrix}\right\}+3aq.$$

The specific gravity of this mineral is 3·363.

On Sulphocarbonylchloride and on a New Chlorosulphide of Carbon, the Perchloride of Methylmercaptan.—B. Rathke.—The introduction to this essay contains an account of the researches made by Dr. Kolbe, some twenty-five years ago, on this subject. The paper then treats at great length on a series of compounds obtained by submitting to fractional distillation the various substances formed by the action of chlorine upon sulphide of carbon. Four different products of fractional distillation were obtained, viz., (*a*) a liquid boiling below 80°, which contains, besides unaltered sulphide of carbon, also chloride of carbon and sulphocarbonylchloride, which imparts to this fluid a reddish yellow colour, and a very suffocating odour; this last-named substance could not be obtained in a free state by fractional distillation; (*b*) at from 80° to 140° a mixture of the substance alluded to under (*a*), and of another body, came over; (*c*) at from 140° to 150° large quantities of a yellowish oily liquid was obtained; while, lastly (*d*), there remained in the retort trichlormethyl sulphonchloride mixed with the oily body just specified. By carefully instituted distillation the author obtained a liquid boiling at between 146° and 147°, of a golden yellow colour, emitting vapours of hydrochloric acid by exposure to moist air, and depositing sulphur at the same time; this body is perchloride of methyl mercaptan, $CSCl_4=CCl_3.SCl$. The author gives a long description of the various reactions which this body exhibits with different reagents.

The Law of Avogadro.—A. Naumann.

Journal für Praktische Chemie, No. 16, 1870.

Concluding Portion of the Essay on the Influence of Temperature upon the Molecular Rotatory Power of some Circularly-Polarising Bodies.—Dr. C. Tuchschmid.—This memoir is illustrated with six lithographic plates.

Decomposition of Sulphide of Carbon by Heat.—W. Stein.—The author relates a series of experiments made with perfectly pure sulphide of carbon. His results show that sulphide of carbon is not decomposed by a very high temperature if charcoal is simultaneously present; it is therefore necessary to keep the retorts plentifully supplied with either charcoal or coke.

Ether of Sulphon-Acids.—L. Carius.—In the introduction to this essay, the labours of various authors on this subject are referred to, and ethyl-sulphon-chloride is described. The further portions of this paper treat on:—Ethyl-sulphon-acid ether.—A colourless fluid, insoluble in water, which slowly decomposes it, even at the ordinary temperature of the air; it boils at 207·5°; $S(C_2H_5)_2O_3$; sp. gr., 1·1508. This substance combines with ammonium, forming ethyl-sulphon-acid-ethyl-ammonium, $SC_2H_5(NH_2C_2H_5)O_3$. Ethyl-sulphon-acid-methyl.—A colourless liquid, also decomposed, when in contact with water; boils at about 200°; formula, $S(C_2H_5,CH_3)O_3$. Ethyl-sulphon-acid-amyl.—The author states that he did not prepare this compound; but that a substance formerly prepared by him, and then named sulphurous acid-ethyl-amyl, is, in reality, ethyl-sulphon-acid-amyl.

Oxamyl-Sulphon Acid (Amyl-Isethionic Acid).—F. A. Falk.—This memoir treats on amylen-chlorhydrine and products derived therefrom, among which is oxamul-sulphon-acid, $C_2H_{10}(HO).SO_2.HO$, and the salts it yields with sodium, ammonium, calcium, barium, copper, lead, and silver.

Isethionic Acid and the Homologous Substances thereof.—L. Carius.—A critical review of a work lately published in Germany under the above title, by Dr. E. Schwarz.

Specific Gravity and Expansion of the Ethyl-Sulphon-Acid Ether.—L. Carius.—The first portion of a lengthy memoir illustrated with woodcuts, and containing a series of tabulated forms exhibiting the results of experiments and analysis.

NOTES AND QUERIES.

Manufacture of Kelp.—Can any reader give me the name of any book on kelp manufacture, and the manufacture of bromine and iodine? I have Richardson and Watts.—A Student.

Orange-Lead.—(Reply to J. Dodd).—You will find every information on the subject in Gentele's "Lehrbuch der Farben Fabrikation," a work which you can inspect at the library of the Commissioners of Patents.

Separation of Tarry Matter from Gas-Water.—(Reply to "Gas Engineer").—Perhaps you might apply filtration of the liquid through a layer of previously well washed pebbles placed in layers of varying thickness and the largest size on the top.

Separation of Tarry Matter from Gas-Water. — The simplest way to separate light tar from gas water is to bring it intimately in contact with heavy tar, and afterwards let settle for a few hours. This will remove the mechanically mixed tar, but not that which is chemically dissolved.—James Donald.

Aniline Colours.—Can any of your readers inform me of the best and cheapest method for precipitating the aniline colours in the form of lakes for the use of paper stainers. According to Perkin's lecture, in the Chemical News, alumina is used along with tannin. I wish to know in what state the alumina is added, also the tannin, and if there are no other earthy substances that will answer the purpose as well as alumina.—Stainer.

MEETINGS FOR THE WEEK.

Tuesday, Thursday, and Saturday, at 3 p.m. each day. Royal Institution. Juvenile Lectures on "Burning, and Unburning." By Professor Odling.

TO CORRESPONDENTS.

*** Our Publisher requests us to remind Subscribers that, if their Subscriptions for the ensuing year are sent to him in advance, the amount for one year will be 18s., no postage being charged; but if accounts are sent from the Office, the subscription will be £1.

China.—Richardson and Watts's "Chemical Technology," will give you full information on the subject. You will also find particulars in "Traité des Matières Colorantes," &c., par M. P. Schützenberger; vol. i., p. 365.

W. R.—We have never seen the statement you allude to.

S. E Phillips.—The formula was an exact copy of the original.

Robinson, Brothers.—(1). If you write to Messrs. Gehe and Co., Dresden, they will probably send you their lists. (2). Messrs. Trübner have published a dictionary which would meet your requirements.

G. Hay.—This correspondent writes to say that in the tenth line of his letter of last week, he used the words "*mixed acids*" instead of "*dilute acid.*"

THE CHEMICAL NEWS.

VOL. XXII. No. 579.

ON A POSSIBLE SOURCE OF ERROR IN PENNY'S PROCESS FOR THE VOLUMETRIC ESTIMATION OF IRON.

By J. SPEAR PARKER.

HAVING occasion to determine the excess of oxygen in an oxide of manganese combined with a considerable amount of cupric oxide, I endeavoured to do so by dissolving a portion in the solution of a known quantity of iron in hydrochloric acid, afterwards attempting to determine the iron remaining in the state of ferrous chloride by titration with a standard solution of potassic dichromate.

On approaching the termination of the reaction I was surprised to observe the well-known brown colour of cupric ferrocyanide when tested as usual by addition to drops of a weak solution of potassic ferricyanide, thus rendering it impossible to obtain an accurate estimation.

This reaction was evidently owing to the formation of ferrocyanide by the small quantity of ferrous salt present, and consequent precipitation of the copper.

This proved to be the case, for, on dissolving some cupric sulphate, together with about one-fourth its weight of ferrous sulphate, and then adding a solution of potassic ferricyanide, the cupric ferrocyanide was precipitated as before. Its identity was readily proved, for on treating the washed precipitate with potassic hydrate, immediate decomposition ensued, the blue cupric hydrate being produced, altering to the black oxide on boiling. The filtrate was of a pale yellow tint, and after acidification gave, with ferric chloride, a Prussian blue, with ferrous sulphate, a bluish white precipitate. The reaction takes place both in neutral and acid solutions, probably according to the following equation:—

$$2K_3Fe'''Cy_6 + 2Fe''SO_4 + 4CuSO_4 = 2Cu_3Fe''Cy_6 + Fe_2'''3SO_4 + 3K_2SO_4.$$

When the amount of copper is small, this brown colouration would not be distinguished from that always produced by ferric salt, and might therefore escape the notice of the analyst, were it not that previous to this the mixture of blue and brown, caused by the presence of a slight excess of ferrous salt, gives a grey or blackish tint, which would at once arouse suspicion. This source of error would seldom occur in practice, being rendered still less probable by the fact that reduction with metallic zinc, which frequently precedes titration, would remove all copper from the solution. Nevertheless, I thought it advisable to place the reaction on record, as I am not aware that it has been previously observed.

ON APPARENT PARALLELS TO REGELATION.

By CHARLES W. VINCENT.

THE re-solidification of broken ice at temperatures above the freezing point has its parallel phenomena under like circumstances in the cases of many other substances. Some of these are well-known, and at times exceedingly troublesome to workmen in certain manufacturing businesses where rapid liquefaction is a desideratum, but have not, I believe, been noticed in any scientific journal. I note a few instances from my own observation.

(1). *Rosin.*—Good black rosin, free from turpentine, when subjected to pressure in a mould, or otherwise, at ordinary temperatures, becomes completely pulverised, its particles showing no cohesive power whatever (the apparatus used was similar to that adopted by Dr. Tyndall for regelation of melting ice).

(2). When the temperature of the mould is raised considerably above the melting-point of rosin, on pressure being applied, a different result ensues; the mass becomes at once solid to the core, the outside alone showing signs of liquefaction.

(3). When rosin has to be melted for manufacturing purposes, if even for a few minutes only the workman neglects to stir, the whole mass becomes completely solidified, and the liquefaction is only carried on at the exterior of the mass, which, when pounded by his stirrer, breaks up without giving the slightest preference to the previous lines of fracture.

(4). The phenomenon is best seen when the temperature of the pan is sufficiently high to melt the outside of the rosin before it has had time to be warmed through.

(5). Pitch, at melting temperatures, gives the same result as rosin, but becomes viscid so much sooner, that though coagulation is readily affected, yet the perfect junction of the broken pieces into a solid mass is not so readily obtainable.

(6). The gums used in the manufacture of varnishes, such as dammar, copal, anime, shellac, &c., give similar results. Whilst being run down at high temperatures, they settle together and cohere (if their surfaces be clean) without the possibility of again separating them in the same places; and this while the exterior of the mass is rapidly melting into liquid of almost the fluidity of oil.

(7). If the temperature of the pan in which any of these viscid substances is being melted be advanced by slow degrees to the point of their real fluidity, the viscidity interferes with the perfect manifestation of the previous results noted—but the aggregating force is still shown—for the separate pieces of rosin, gum, or such like substance, take the same degree of viscidity, and combine into one homogeneous mass, whilst the more rapid melting goes on on the outside of the whole.

(8). From these instances I am inclined to infer that the disintegration caused by liquefaction of one part of these bodies causes them to exert a greater power of aggregation in the parts less exposed to heat.

Royal Institution, December 28, 1870.

ON THE EXAMINATION OF THE BESSEMER FLAME WITH COLOURED GLASSES AND WITH THE SPECTROSCOPE.*

By J. M. SILLIMAN, M.E.,
Adj. Professor of Metallurgy, Lafayette College, Easton, Pa.

I. *Examination with Coloured Glasses.*

IN the Bessemer process, the progress of the decarbonisation is determined chiefly by the appearance of the smoke, flame, and sparks which are emitted from the apparatus. Owing to the rapidity with which the reactions take place, it is highly important to catch the exact moment when the blast should be turned off. This is indicated by the colour and brightness of the stream of gas issuing from the converter, and by this the moment of total decarbonisation can generally be accurately determined by the naked eye. When, however, pig-iron of certain qualities is used (manganiferous iron, for example) this determination is very difficult; even those who have had much experience make frequent mistakes and find it impossible to produce the same quality of steel at every blow.

In order to intensify these flame-indications, use has been made of the spectroscope, and also of various combinations of coloured glasses. The former was first

* Read at the Troy Meeting of the American Association for the Advancement of Science.

attempted by Dr. Roscoe, and the latter by Mr. Rowan at the Atlas Works.

Mr. Rowan experimented with a great variety of coloured glasses, and obtained the best results by using three glasses, two of ultramarine-blue and one of dark yellow. This little instrument, or chromopyrometer, as he terms it, is now in daily use at the Atlas Works, its indications being so marked and unmistakable as to render its use safe in the most inexperienced hands.

The following experiments were made at the Bessemer Steel Works of John A. Griswold and Co., in Troy, while pursuing the chemical course in the Winslow Laboratory of the Rensselaer Polytechnic Institute. In my observations on the flame I made use of the spectroscope, and also of a combination of coloured glasses. This combination consisted of two light yellow glasses and a blue one, through which the sunlight appeared of a deep purplish-blue tint; and as it differed slightly from Rowan's, it gave somewhat different results.

In order to reproduce the appearance of the flame at the different stages of the process, I prepared a plate consisting of about a hundred varieties of colours and tints, all of which were numbered and thus referred to a table which indicated their composition. They were also arranged to be seen with either a light or dark background. The use of this plate was of necessity limited to daylight, but the illustration and description are given as occurring at night in order to show its illuminating power.

At the beginning of the process that which issues from the converter does not appear to be a true flame, but only an illumined stream of gas carrying with it innumerable red-hot pellets of iron. This gas has scarcely any illuminating power, extends but for a short distance from the mouth of the converter, and is sometimes sheathed with a whitish smoke. Seen through the glasses, the flame and sparks have a deep crimson colour, the converter is invisible, and at the base of the flame is a crimson band which continues throughout the process.

As the reaction continues, this stream of gas grows brighter and more elongated, and, after a few minutes a small pointed whitish flame appears, which suddenly increases in size. At this instant the blast-pressure falls from 20 to 18 pounds.

When viewed through the glasses, the upper part of the converter comes dimly into view, and the flame and pellets of iron appear of a lighter colour, while the fragments of slag which begin to be thrown out are of a deep red. This difference in shade between the iron and slag thrown out is, probably, entirely owing to the lower temperature of the latter, for the reason that while the iron is discharged from the metallic bath the slag is washed up on the sides of the converter, and can be seen clinging around its mouth in a spongy mass until detached and thrown out by the blast. The greater porosity of the slag and its consequent more rapid cooling would also cause a difference of temperature.

In the second period the discharge of slag increases, and the flame is very bright and illuminating, with occasional dark streaks. Through the glasses at the beginning of this period the flame is of an ashy blue colour with streaks and flashes of crimson, the edges being sometimes of a purplish hue. At this point surrounding objects are illuminated, and the converter becomes distinctly visible. A wreath of crimson is seen surrounding the flame where it strikes the chimney. By the middle of this period the crimson almost entirely disappears from the body of the flame, leaving only a slight cone at its base, and a border of greenish hue makes its appearance, and gradually grows more decided. Streaks of a dark blue colour are also seen in the body of the flame.

The beginning of the third period is scarcely indicated to the naked eye, though the flame becomes somewhat weakened, and after a few minutes shows dark streaks running through it. Through the glasses at the commencement of this period the rose-coloured cone begins to expand and deepen, the greenish sheath is more decided, while streaks of dark and green are visible. After a few minutes the change becomes very rapid, a few seconds only being required to reduce the flame from rose-colour to the deep crimson non-illuminating gas, as at first, and again the converter is lost to view, by which time the blast should have been turned off.

The gradual fading of the crimson from the beginning of the blow and its deepening at the termination of the process, as well as the crimson band at the base of the flame and the wreath of crimson surrounding the flame at the chimney, tend to confirm Mr. Rowan's views, which are, that the different shades of crimson are due to changes of temperature. The stream of gas which comes from the mouth of the converter at the beginning of the process, being illumined from within, derives its colour from the metallic bath, the temperature of which, owing to the combustion of silicon, increases more rapidly during this period than at any other.

The crimson band at the base of the flame, and the wreath of crimson at the chimney might also be accounted for by this theory. The flame rushing from the mouth of the converter has a tendency to create a vacuum at its base around the converter's edge, and thus to cause a wreath of flame to pass over this surface, and by consequent cooling produce the crimson band. The wreath of crimson at the chimney may be also due to the cooling of the flame consequent upon deflection.

It is true we have a seeming contradiction to this theory in the rose-coloured cone extending from the base at the centre, which we would naturally consider the hottest part of the flame; but, as in the flame of the Bunsen burner, the hottest part is in its outer sheath, the conditions of combustion in both being similar, it is probable that that part of the flame occupied by the cone is at a lower temperature than that surrounding it.

The green streaks in the flame are most intense when the manganese spectrum is brightest; and as the colour of the flame when the spiegeleisen is added is also green, we are led to suppose them due to the presence of manganese.

On two occasions simultaneous observations were made with the spectroscope and the coloured glasses; but with the exception of that just mentioned, and the changes at the commencement and termination of the blow, no striking coincidence was noticed.

(To be continued).

ON THE EXTRACTION OF THE POISONOUS PRINCIPLE OF THE TUTU PLANT (CORIARIA RUSCIFOLIA).

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

A GREAT many experiments have, from time to time, been made upon the Tutu plant, with the object of extracting the formidable poison known by sad experience to exist therein; but, as is well known, these attempts have been always unsuccessful, and have, besides, completely failed to discover anything at all definite as to the chemical or physical character of the poison.

Among these experiments is a series I made while connected with the Geological Survey Department of Otago, a notice of which appeared in the "Juror's Report for the New Zealand Exhibition of 1865," the only result, however, being to prepare the way for future inquiry, which was promised at the time.

The Tutu plant does not grow in the neighbourhood of Wellington in any quantity, hence I have been greatly delayed in fulfilling my promise, much against my will; but recently a large quantity of the seed of this plant has been kindly presented to the Survey, for this particular purpose, by Mr. H. H. Travers, and upon this I at once commenced operations.

The plan I adopted was to separate, as well as I could, all the more immediate proximate constituents of the seed (in which the poison is known to exist), and to test each likely one by itself, in its effects upon the animal economy.

First, I extracted a portion of the finely-ground seed with cold water, and another portion with weakly acidified water, and treated them separately by a new process, now much in vogue, for the separation of alkaloids (Rogers and Girwood), all the evaporations being conducted at a temperature not exceeding 90° F.

The residuum from these processes was very small, and gave no indications of the presence of alkaloids to the proper tests; it consisted almost wholly of gummy matters.

The result seemed to dispose of all that was soluble in water or weak acids, and, to a certain extent, impugned the correctness of the general idea that this poison is of the nature of an alkaloid.

The part of the seed insoluble in these reagents was next examined.

Alcohol was passed through this repeatedly, and the extract evaporated, when a large quantity of a greenish-red coloured substance discovered itself. This, treated with ether, separated into two parts, one a green-coloured oil, soluble therein, the other a resinous substance quite insoluble in this menstruum.

The resinoid substance was reserved for after-examination, and the oil at once tested in regard to its effects on the animal economy.

For this purpose I administered about five minims of it to a full-grown cat, after a twelve-hours' fast; the oil acted as an emetic in a short time, and the greater portion of it was vomited. In half-an-hour, however, the animal showed signs of uneasiness, and convulsive twitches of the ears and eyes, together with a forward jerking of the head, took place, also much frothing of the mouth, culminating in a convulsive fit, in about one hour after the dose was administered. After a little while this fit passed off, only the twitches and forward jerkings continuing; but a second very severe fit, of short duration, occurred in about one hour afterwards, after which the cat gradually rallied. These symptoms agreed generally with those exhibited by cattle and sleep, when poisoned by this plant.

Although I have made but one experiment, I think it will be allowed that the result of this has fairly proved that the poison of the seed, and so, by a very proper inference, the poison of the plant generally, since I find an oily substance throughout it, exists in this oil, if it is not the oil itself. It therefore now only remains to be ascertained whether this oil is a single proximate substance or a mixture or compound of such, and if the latter, which is, or which are, the active ones concerned in the production of these phenomena I have described. Unfortunately, I had not sufficient of the oil to allow me to test this properly, but I am in hopes of having it shortly, as I have been promised a large quantity of these seeds from Taranaki.

The following are the characteristics of this oil, as ascertained up to the present time.

Somewhat viscid at common temperature, but flowing freely at a little above this; colour, pale-green; reaction, acid; taste, bland; burns away readily with much flame; scarcely volatile without decomposition; soluble in ether, alcohol, chloroform, and strong acetic acid; insoluble in hydrochloric or nitric acid; also insoluble in water; does not dry when long exposed to the air.

When boiled with solutions of the caustic alkalies there is much frothing, but only a portion of the oil dissolves, even when the boiling is continued for many hours; the portion dissolved was found to be saponified. The whole of the oil is, however, soluble in a cold alcoholic solution of potash, without yielding a precipitate when admixed with water; hence it is probable that all the acid portion of the oil is really saponifiable, that which was unsaponifiable, in the first instance, being a product of the metamorphosis of a portion of the normal oil by the process employed.

When the oil is heated to the decomposing point, a substance is given off having the pungent odour of acrolein, a substance chracteristic of the presence of glycerine, or oxide of lipyle, the base of common fatty bodies.

Heated with caustic alkalies, either in the wet or the dry way, there are no alkaline vapours evolved, but in the latter case an odorous oil forms, probably œnanthylic acid.

From the reaction of this oil, here described, it evidently belongs to the series of non-drying fixed oils; in its solubility in alcohol or acetic acid it bears a remarkable resemblance to castor-oil, the only other fixed oil which I find to be wholly soluble in acetic acid. Now, castor-oil, it will be remembered, is a very peculiar oil. It does not contain any of the acids of the common oils or fats, but, in place of them, two very singular acids, quite peculiar, I believe, to this variety of oil; hence I conceive that the acid part of this oil of Tutu to be also quite distinct from the ordinary fatty acids; to be in all probability, peculiar to it; and to one or more of these acids I should ascribe the poisonous effects of the oil.

If further experiments should confirm the correctness of the views here stated, this case will, I conceive, become invested with an interest beyond that immediately under our notice, since it will offer another instance in which a non-nitrogenous oily principle is proved to affect the system like a neurotic poison, this class of poisons being almost always alkaloids, or at least nitrogenous substances.

Now it will be remembered there are several poisonous plants in Europe, which have, hitherto, refused to yield any pure poisonous principle to chemical processes, but then these processes have been, as a general rule, I believe, especially for the detection of alkaloids. With this case to point, therefore, it does seem in the highest degree probable that, in some of these cases, at least, the poisonous effects may be due to a non-nitrogenous oil, not yet isolated or examined. In view of this I have recommended the subject for examination to a friend of mine residing in England, so that I expect in a few months to hear something more of this, or else to have selections of seeds, &c., from the plants I have named in my letter, so that I can inquire into this subject myself.*

With regard to antidotes for administration to animals, &c., poisoned with the Tutu plant, I should be inclined to think that, in addition to emits and purgatives, very dilute acids would be beneficial, since, by preventing saponification of the oil, they would tend to keep it insoluble, and therefore inert.

As being somewhat related to the subject, I may state that the seed of the Karaka tree (*Corynocarpus lævigata*), which is also of a poisonous nature, has refused, in a similar manner, to yield any alkaloid to my processes, but it gives up an oil to alcohol, which resembles the above in some of its reactions. It seems to exercise a specific effect upon the animal economy when administered in small doses, inducing at first great uneasiness, and afterwards restless, unwilling sleep, with sudden starting. Unfortunately I had not sufficient of it to get any decisive results.

This oil is also soluble in alcohol, acetic acid, ether, and in hydrochloric acid.

It is very bitter, and feebly soluble in water.

In one important respect it differs from the oil of Tutu. It evolves ammonia when boiled with potash, thus, in regard to its composition, allying itself to the alkaloids, though in its reactions apparently distinct.

* Since this paper was read, I learn from the CHEMICAL NEWS (vol. xx. p. 70) that M. Van Ankum has discovered the poisonous principle of the *Cicuta virosa* to be an essential oil, of formula $C_{10}H_8$, but "could not find any alkaloid in this plant at all." This was one of the plants especially selected for examination in the communication alluded to.

ON FERMENTATION.*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from page 305.)

IN the composition of alcoholic ferments there are several substances of which we know very little at present, I am sorry to say, but the want of this knowledge is so great that I have no doubt it will be soon supplied. Certainly this is a most important field for the investigation of naturalists who possess an accurate knowledge of chemical manipulation; I mean the simplest and lowest organisms, whose functions are of such importance in these changes, certainly claim much careful investigation. But some of the things which we do know about the yeast cells I must now state, with relation to the facts and ideas which we have just had before us. In the first place, with regard to their growth; it is very common, in the process of brewing, to feed the yeast cells with a substance which is formed in the germination of barley. When barley is left in a moist state, at a suitable temperature, it begins to sprout, and during that process there is a change in two of its constituents, which I showed you the other day. One is gluten, a body containing nitrogen, which I compared, for the sake of convenience, to muscular fibre, being in reality very closely allied thereto in chemical composition, and during the germination of the seed this substance passes over into some product or products—I had better speak quite generally—known by the name of diastase. In the yeast cells there is a substance very nearly resembling in composition that of gluten, and it cannot be doubted that this gluten, or albuminous body as it is frequently called, is capable of undergoing a similar transformation into diastase, and of all foods the yeast cell enjoys most those which contain diastase. I have a good many yeast cells growing in a suitably heated chamber, and those which seem to thrive most are some which were put into an infusion of malt, to which sugar was added. It is common, in the process of fermentation, to put in yeast in tolerable quantity, but the extent to which it grows depends upon the time for which it is left in contact in the material. I am told that the common proportion is about one-twentieth of the quantity of yeast required. For instance, if 20 lbs. of yeast are wanted to effect a given fermentation, you put into the liquid which has been fermented 1 lb. of yeast calculated in the dry state, and give it this diastase to feed upon. At the same time, there is sugar present in the liquid, and during the process of fermentation this pound weight of yeast increases more and more, by a process of true germination and growth. Professor Mitcherlich actually saw, under the microscope, some little cells, of yeast sprout, and put out, from the side of the parent cell, small cells which gradually increased in size. The actual process, however, has not been seen by many observers. And not only does the yeast cell in that way feed upon these albuminous bodies, which are grouped together by the name of diastase, but it also takes part of the sugar; and these are the two prominent facts which we know with regard to its food—that it feeds upon substances of those two classes; sugar, which contains no nitrogen, and also nitrogenous substances, which are formed by the partial breaking-up of the gluten. On the other hand, its decomposition—I mean during its life—I am not speaking of any decomposition which its materials may undergo if it is killed—gives off alcohol, carbonic acid, succinic acid, and glycerine; in fact, the four chief products of ordinary alcoholic fermentation, which I enumerated to you the other day. And while these products are being given off, there is at the same time a considerable quantity of nitrogenous substances being given off. The albuminous matter in the yeast cells is undergoing decomposition, and is giving off nitrogenous substances. There is not any well-authenticated case of the yeast cell forming, during its active functions, products of complete breaking-up or putrefactive decomposition; all the products which we know best are substances of considerable complexity—less complex than the materials of the plant, but of great complexity; and, accordingly, the notion which Liebig had that the yeast-cell is active in the proportion as its materials are undergoing complete analyses or breakings-up, and forming ammonia and carbonic acid, is not now entertained by that distinguished philosopher.

Some time ago, an exceedingly important experiment was made by M. Pasteur, with a view of testing the vital functions of the yeast cells in a definite way. The statements which I have made to you contain a good many terms which are exceedingly general, as, for instance, the allusions to diastase. We really do not know what that is. We know about what sort of a thing it is made from, but not definitely. And the same with the nitrogenous products which are given off by the yeast cells; we know something about them, but only a little. Pasteur put into a solution of sugar, in which some yeast particles were present, some ammonia combined with an acid, and at the same time he put some of the ashes of other yeast cells. He took a certain quantity of yeast and burnt it, so as to remove by oxidation the carbon, hydrogen, and nitrogen of the substance, and the earth substances which remained, which are essential to the formation of a new yeast cell, he put into some fermenting liquid, together with some salt of ammonia. When he did that, he really was treating the yeast cells very much in the same way as a good farmer treats the wheat plant. If you want a wheat plant to increase rapidly, you must, in the first place, take care to supply to it all that the wheat plant takes up in the shape of mineral matter from the soil, and the best way to find that out is to burn some wheat and see what is left. Then you must supply plenty of ammonia, and the more ammonia you supply up to a certain extent, the more rapidly does the wheat grow, by building up various simple substances into the complex substance, gluten, which I was speaking of just now. Pasteur put into such a mixture a few little cells of the yeast, and they did not thrive. They did transform some sugar into alcohol and carbonic acid, but they evidently were not at home, and at the end of a certain time, I forget how long, he found there was actually a smaller weight of yeast present than he had put in. That was a very different result from what happens when nitrogen is supplied to the yeast plant in the form which I mentioned just now as the usual one; and I think the fact is most instructive, and serves to show us what kind of a being the yeast cell really is—I mean whether it should be classed among animal or vegetable beings. I need hardly say that absolute distinctions amongst beings which we find in nature are out of the question; we do not generally get any absolute line of demarcation, for one class flows over into the other; but still the ideas which serve us to classify organic and other beings are exceedingly important, and in a case like this it is certainly of considerable interest to have some leading idea, by which one may see whether there is a reason for placing these beings amongst vegetable or animal organisms, and we cannot help giving special weight in that respect to the kind of process which the respective classes of beings carry out in their organisms. Plants build up complex substances from simple. All the most complex substances that we can get are made in the organisms of plants. They may have been taken over by animals from plants, but they are formed in the main by plants. And the chief chemical activity of animals is precisely opposite; they take those complex substances and break them down, by means of their vital functions, to the simple products which are exhaled and given off in the processes of animal life. Therefore, the question whether the process which the yeast carries on is a synthetical process—a building up, or whether it is in the main an analytical process, is certainly one of the most important which can guide us. Now, I think what I have said must appear to you all most conclusive in that

* The Cantor Lectures. Delivered before the Society of Arts.

respect—that what we know best regarding the nature of the yeast cells, the food which we know they take in large quantities, and upon which they live, is certainly exceedingly complex, and what the yeast cells take up in preference is certainly sugar, and the very complex nitrogenous substances which are at present in solution in the malt, and the products which they give off are exceedingly simple in comparison. Their functions are in the main (those which we know best, at any rate) analogous to those which take place in animal organisms, and are most remote from those which take place in vegetable organisms.

In a paper which he has recently written on the subject of fermentation, Liebig has drawn attention, amongst other things, to the circumstance that the common alcoholic ferment can be made to eat tartaric acid. If you were to neutralise a solution of some of these crystals in water, and put with the solution some yeast cells, at the same time supplying some nitrogenous material, the yeast plants would grow, and transform that into other substances. In the same way, if you were to put in some of this malic acid (which got its name from the circumstance that it is present in sour apples), the yeast cells would also transform that; and the same in other cases. One of the most remarkable decompositions is that of nitric acid, which, by the action of the yeast cells, is deprived of some of its oxygen, and converted into nitrous acid, so that it would appear that the plant can actually assimilate or eat the nitrates, forming these simpler derivatives from them.

There is one case which I should like to show you, of an inorganic action, one in which there is no vital process concerned, but it bears a sort of general resemblance to what I conceive to be the principle of those which I have been speaking of. I have here a piece of platinum in a peculiar state, which is well described by the term "spongy." If I hold it in the flame of common coal-gas mixed with air, from a Bunsen burner, the spongy platinum eats the air or the oxygen contained in it and the gas. The word "eat" is not really so inappropriate as it may seem. If I were to put this spongy platinum into oxygen, I should find that it would combine a quantity of oxygen into its substance, and make it part of itself, and the same with regard to the coal-gas. So that here you see, from the heat which was given off, the substance is really effecting a chemical change upon the materials which it absorbs, and it effects that change in its own substance. It is admitted that, in some way or other, the yeast organisms—I will not again call them plants—actually assimilate and make part of themselves, the sugar, or tartaric acid, or whatever it may be which they decompose; but they do not give off that substance which they have eaten in the same form. They give off its elements, after they have undergone a re-arrangement in other ways. At our next meeting I propose to bring before you some different considerations regarding the vital functions of these organisms, and some points which bear upon questions of sanitary importance.

(To be continued).

ON THE ESTIMATION OF GRAPHITE IN CARBURETTED IRON.

By M. BOUSSINGAULT.

CAST-IRON and certain kinds of steel contain carbon in two different states, viz.: (1) combined with the iron and therefore not visible in separate particles; (2) disseminated through the metal either in the form of an amorphous black powder, or in that of brilliant crystalline laminæ, constituting the graphite of the metallurgists. There is some ground for the belief that while cast-iron is in the molten state all the carbon it contains is then chemically combined therewith and dissolved, as it were, in the iron, but, on cooling, it appears as if a portion of that carbon is set free. Black granular cast-iron (granular on the fracture) exhibits a number of lamellæ of graphite, This is less prominent in grey cast-iron, and it is not visible in white cast-iron, neither in the kind called spiegeleisen, in both of these it can only be detected by careful analysis. When carburetted iron is dissolved in chlorhydric acid, the state of the carbon is at once shown. The free carbon or graphite remains along with the other insoluble matters. When iron does not contain graphite, but only combined carbon, there is no carbonaceous residue left on the iron being dissolved in hydrochloric acid, but in that case the carbon is eliminated during the solution of the iron in acid, communicating at the same time to the hydrogen gas evolved a peculiar and characteristic fœtid odour. Steel which contains neither graphite nor scoriæ (siliceous and other matters derived from the flux) dissolves in the acid without leaving a residue. When a grey cast iron is dissolved in hydrochloric acid, it will evolve a fœtid hydrogen, but leave simultaneously a carbonaceous residue, because such kind of iron contains carbon in the two conditions of combination, as well as mixture.

In the year 1799 Proust first called attention to the oily matter developed during the action of an acid upon black cast-iron. He discovered that a portion of this oil was carried off by the hydrogen gas, communicating to it an alliaceous odour, while another portion remained combined with the carbonaceous insoluble residue, from which it might be extracted by means of alcohol. When cast-iron is acted upon by hydrochloric acid the graphite contained in the iron is separated, while the combined carbon is eliminated during the reaction along with the hydrogen gas. The graphite left as a residue insoluble in acid can be quantitatively estimated by burning it in oxygen gas, its weight being determined by the loss of weight of the insoluble residue, provided the iron were fully dissolved, and even if some portion of that metal has remained undissolved, it is possible to estimate the quantity of graphite by this method, by so arranging the apparatus as to admit of weighing the quantity of carbonic acid obtained. When we have to deal with a mixture of graphite and carbon of combination, such as is, for instance, obtained by the action of bichloride of mercury upon grey cast-iron, the quantitative estimation of the two species of carbon is effected by first heating the mixture to a temperature not exceeding dull red heat, and with contact of air, whereby the combined carbon burns off, and the graphite being left is next consumed in a current of oxygen aided by a white heat; there remains after that the silicate due to the silicium of the iron. This silica sometimes contains slag. After every combustion it is best to heat the residue in a current of hydrogen gas, in order to reduce again to the metallic state any iron which might have been left among the carbonaceous matters. I have especially adopted this method of estimation of graphite and combined carbon in iron in order to save the trouble of recurring to the long and tedious process of organic elementary analysis. Although the estimation of graphite and combined carbon in iron by the method founded upon the different combustibility gives very correct results, I have deemed it necessary to compare these results with those obtained by the previous separation of graphite followed by its combustion, while simultaneously I could study the nature of the residue left by a graphitic iron when dissolved in an acid.

(1) *Doubly Cemented Steel.*—1·5 grms. treated by the bichloride of mercury yielded:—

	Grm.
After volatilisation of the protochloride, carbonaceous matter	0·030
After combustion in air and reduction (by hydrogen), a graphitic residue	0·013

Carbon burned in air	0·017 *
After combustion in oxygen and reduction, greyish white residue of silica	0·005
Carbon burned in oxygen	0·008

Therefore 1 grm. of steel contains :—

Combined carbon	0·0113
Graphite	0·0054

(2). Five grms of the same steel have been treated with chlorhydric acid. When the metal is dissolved the liquid has been boiled for a few minutes, the insoluble residue has been collected upon a plug of asbestos placed in the neck of a funnel, washed with boiling hot water, dried, and next heated to redness in a current of hydrogen gas.

	Grm.
The remaining residue weighed	0·058
A whitish residue after burning in oxygen ..	0·025
Graphite burned	0·033

For 1 grm. of steel :—

Graphite	0·0066
Estimation according to 1	0·0054
Difference	0·0012

1 grm. of steel has yielded :—

Silica according to 1	0·0034
Silica according to 2	0·0050

As regards the silica I ought to observe that neither of the two methods answers the purpose of correct estimation of that substance, because a portion of the silica is dissolved.

White Cast-Iron of Ria (Pyrénées Orientales).

(1.) 1·5 grms. of this cast-iron treated with mercury yielded :—

	Grm.
Carbonaceous matter	0·089
After combustion in air and reduction, slightly grey-coloured residue of silica	0·028
Burned-off carbon	0·061

For 1 grm. of the cast-iron :—

Carbon burnt off	0·0406
Silica	0·019†

(2.) Five grms. of the same cast-iron has been acted upon by hydrochloric acid. The hydrogen gas given off during this operation had a very fœtid odour. The liquid containing the insoluble residue had been boiled, and, further, been treated as already mentioned above in the case of the steel similarly treated.

	Grm.
The greyish coloured residue after reduction weighed	0·043
Weighed after being heated in oxygen and reduction	0·040
Graphite burned	0·003

The remaining residue was silica-like, quite white, and disappeared when treated by fluorhydric acid. One grm. of this cast-iron yielded, therefore, by this process :—

	Grm.
Graphite	0·0006

The quantity of combined carbon which has disappeared during the dissolution amounts to 0·203 grm.

Grey Hot-blast Cast-Iron from Ria (Pyrénées Orientales).

(1.) Treated with bichloride of mercury 1·5 grms. of this metal yielded :—

	Grm.	For 1 grm.
Carbonaceous matter	0·0645	—
After combustion in air and reduction	0·0540	—
Burnt-off carbon = combined carbon	0·0105	0·0070
After combustion in oxygen and reduction, white silica left ..	0·0050	0·0033
Burnt-off graphite	0·0490	0·0327

(2.) Five grms. of the same cast-iron treated with hydrochloric acid left a black-coloured residue, which, after having been treated as mentioned above, weighed :—

	Grm.
	0·257
After combustion in oxygen, white silica left	0·105
Graphite burnt off	0·152

This amounts for 1 grm. of cast-iron to—

Graphite	0·0304
Silica	0·010

As already stated above, neither the treatment with bichloride of mercury nor with hydrochloric acid gives proper results for the quantitative estimation of the silica. When the Ria cast-iron is acted upon by *aqua regia*, and the process so conducted as to render all the silica insoluble in weak acid, 1 grm. of the metal yielded 0·0234 grm. of silica, equal to 0·0111 grm. of silicium. When grey cast-iron is dissolved in chlorhydric acid it is very probable that silicium is converted into silica, for I have found that when artificially-prepared siliciuret of iron is treated with an acid, silica only is obtained, partly in soluble, partly in insoluble, condition. If the carbonaceous residues above mentioned had contained a siliciuret or protoxide of silicium, the weight of the substances determined would have become greater than the quantity of matter submitted to combustion in consequence of the absorption of oxygen by the silicium. The results of these experiments are :—(1) When a carburetted iron is dissolved in chlorhydric acid, the total quantity of the carbon combined with the metal is eliminated, while the free carbon remains mixed with the other substances insoluble in the acid. (2) Since the residue left by a grey cast-iron treated by hydrochloric acid, contains a portion of the silicium which was combined with the iron in the state of silica, that residue does not contain any graphitoid silicium nor protoxide of silicium; the estimation of the silica in the residue does not represent the whole of the silicium contained in the cast-iron, because a portion of the silica remains in the acid liquid. (3) That the process based upon the difference of combustibility of the combined carbon and graphite is sufficiently exact to estimate the two kinds of carbon obtained by the action of bichloride of mercury upon the carbonaceous residue of cast-iron or steel.—*Ann. de Chim. et Phys.*

* Combined carbon.

† Since the mixing with the bichloride of mercury has been performed in a glass mortar, there is a chance of silica having thus been introduced.

NOTICES OF BOOKS.

Report of the Deputy Master of the Mint on European Mints. Ordered by the House of Commons to be printed, August 10th, 1870.

This report has been drawn up by the Deputy Master of the Mint, in obedience to an order of the Lords Commissioners of Her Majesty's Treasury, whereby that gentleman and two officers of the Mint were requested to make a careful inspection of the management and working of the principal Mints of Europe; that is to say, those established at Madrid, Milan (where the Mints of the kingdom of Italy are in process of concentration), Florence, Rome, Constantinople, Vienna, St. Petersburg, Stockholm, Copenhagen, Berlin, Utrecht, Brussels, and Paris. We shall only quote from the Deputy Master's Report the headings of the subjects treated of, viz., Administration,

Mint Buildings, Refining, Standard of Fineness, Remedy of Fineness, Brittle Gold, Silver Melting, Levol's Experiments, Method of Taking Assays, Waste, Sweep, Dies, Verification of Gold Monies, Verification of Silver Monies, Annealing and Blanching, Size of Moulds and Bars, Rolling, Adjusting, Cutting, Adjustment of Blanks, Weighing Blanks and Coins, Remedy of Weight, Marking, Coining Presses, Balances.

Our readers will readily perceive from this catalogue that many subjects are treated of which, however interesting in themselves as bearing upon the speciality of the requirements of those manufacturing establishments which are termed Mints, are of less interest to the chemist.

There are, however, added to the report two appendices, termed enclosures, written by the gentlemen who accompanied Mr. Fremantle, the Deputy Master, on his inspection tour, the first thereof being from Mr. W. Chandler Roberts, Chemist to the Royal Mint, the other from the hand of Mr. James Murdoch Napier. This second report bears almost entirely upon mechanical operations, and, although of high value, and evidencing in a high degree the author's eminent knowledge in this respect, we will not further allude to it here, but confine our quotations to those taken from Mr. Roberts's extensive and valuable report.

The points named for consideration in this report are—

"Refining. Gold alloys. Gold melting. Silver melting. Subsequent treatment of gold and silver (annealing of fillets, annealing of blanks, and blanching). Loss. Treatment of residues or 'sweep.' Verification. Adjusting blanks. Dies. Bronze."

Under the head of Refining, the following information is given on *brittle* gold:—

"Immediately connected with this subject is the fact that gold frequently contains minute traces of lead, arsenic, antimony, and bismuth. These metals, even when present, to the 1-2000th part of the mass, render the gold brittle and totally unfit for coining, probably by enabling the alloy known as standard gold to assume a crystalline structure. I find that on the Continent, those countries which have an extensive gold currency are but little troubled with brittle gold. The reason is obvious; the impure metals are removed by refining, which forms, as I have stated, one of the ordinary operations of the Mint; and the utmost care is taken to conduct the process in an efficient manner. With regard to the direct treatment of brittle gold, it is needless to remind you that the experiments in the English Mint have proved the advisability of adopting Miller's process."

Since the melting of the valuable gold and silver alloys as used for coinage is an operation of great importance we quote in connection therewith the following:—

"*Gold Melting.*—I now proceed to the description of gold melting. The nature of the gold to be operated upon, and its degree of fineness, having been determined by assay, a simple calculation will give the amount of copper to be added to form standard gold.

"*Crucibles.*—The crucibles in which gold is melted were formerly of refractory clay, and this material is still retained in the Mints of France and Belgium. It has in England been superseded by a mixture of graphite and fire-clay, known as plumbago. The amount of gold melted in each crucible is, in the British Mint, from 100 to 108 lbs. (or 37·3 to 40·3 kilogrammes), and I find a similar quantity is operated upon in other European Mints, the exceptions being those of St. Petersburg, Paris, and Vienna, which usually melt a larger quantity. The admixture of the metals is a matter of extreme importance, and this is effected by means of a stirrer of the same material as the crucible, in the form of a rod flattened at the end, and often of a spiral form. The copper is in all cases protected from oxidation by placing charcoal in the crucible.

"*Method of Pouring.*—In the English Mint the crucible is removed from the furnace by means of circular tongs, and the contents poured directly into moulds. In many European Mints it is the practice to transfer the melted alloy from the crucible to the moulds by means of iron ladles covered with clay.

"*Mode of taking the Portion of Metal for Assay.*—In England it is usual to cut the portion of metal to be assayed from the bottom of the solidified bar. In many continental Mints the portion of metal taken for the verification of the standard is removed by a small ladle from the crucible; and at Constantinople the sample is taken after half the alloy has been transferred to the moulds. The bars of standard gold for the coinage of sovereigns at the English Mint are 1·375 inches wide, 1 inch thick, and 24 inches long. In other European Mints, with the exception of that at St. Petersburg, bars are cast of much smaller dimensions, those in Berlin being only three sixteenths of an inch thick. I consider that this practice presents many advantages, but in this case I defer my remarks until treating of silver melting.

"*Gold-melting Furnaces.*—I have examined with care the furnaces employed for gold melting. That furnace is best in which the combustion of the fuel is most perfectly effected; indeed I had hoped to have met with gas furnaces, as I am of opinion that their introduction into the English Mint would be very advantageous, not only from their cleanliness, but from the fact that the temperature would be completely under control. At Milan it was stated that plans are in preparation for the construction of gas furnaces, and should the Mint be removed from its present site, the advisability of the employment of gas as fuel shall receive my earnest consideration. The furnaces employed in the English Mint for melting gold are 24 inches (0·61 metre) deep by 12 inches (0·305 metre) square. I do not consider that any change should be made in the general construction of the furnaces as at present in use in the British Mint, but with regard to minor details, I am of the opinion that the openings might be altered with advantage. It is also a question for consideration whether, if the furnace opening were on a level with the floor, the necessary manipulation would be attended by less inconvenience to the operators. This arrangement is adopted at Stockholm, where, however, the amount of gold melted is extremely small."

"*Crucibles for Silver.*—The crucible at present employed in England for silver melting is of wrought-iron, 12 inches (or 0·305 metre) in diameter, and capable of containing from 333 lbs. to 416 lbs. of metal. At Milan silver is melted in very thin wrought-iron crucibles, in which 1607·5 lbs. (600 kilogrammes) are acted upon at one operation. The iron is protected by a thin but coherent film of fire-clay. At Brussels the crucibles are also of wrought-iron, of 2679 lbs. (1000 kilogrammes) capacity. The Vienna, St. Petersburg, and Utrecht Mints employ crucibles of cast-iron, capable of containing from 1607 to 2143 lbs. (600 to 800 kilogrammes). Those of Madrid, Constantinople, Rome, and Berlin employ crucibles of graphite, the capacity varying from 535·8 to 2529·1 lbs. (200 to 944 kilogrammes), as at Constantinople. I have no hesitation in recommending that graphite crucibles should be employed in preference to iron. Iron crucibles invariably absorb portions of silver either in the scales of wrought-iron, or even in the actual cavities of cast-iron. Indeed the crucibles at Vienna often contain many pounds of silver, and this is recovered by dissolving the iron with acid residues from the refinery. One other objection is that the silver becomes contaminated with iron. Graphite crucibles permit of the total contents being poured into moulds, and this enables the accounts to be adjusted daily, a point of Mint administration the value of which cannot be over-rated."

"*Graphite Crucibles.*—Experiments have recently been instituted in the English Mint, upon silver melting in graphite crucibles, containing 143 lbs. (53·37 kilos.), and have been attended with excellent results. The silver is either directly poured into moulds, or transferred by means of iron ladles lined with clay. In England the

silver bars are one inch thick; whereas, as I have already stated with regard to gold, in most European Mints the bars are of much smaller dimensions. In most European Mints, before the silver alloy is cast into bars, the contents of the crucible are stirred, and a small quantity of the metal removed by a ladle lined with clay or (as at Utrecht) by a pair of forceps which open in the molten mass, and enclose a button of metal. This test piece is assayed by the volumetric method, a process which occupies from 15 to 20 minutes, and, as in most cases the amount of alloy operated upon is very considerable, there is no inconvenience in maintaining the contents of the crucible in a molten state until the assay is completed. The melter is thus enabled to adjust, if necessary, the relative proportions of the constituent metals. The portion of metal taken from the crucible represents the actual composition of the standard silver with far greater accuracy than a test piece cut from the end of the bar of the solidified alloy."

"*Levol's Experiments.*—In order to explain this, it is necessary for me to enter somewhat minutely into the consideration of an important series of experiments conducted in the Mint at Paris by Levol, on the remarkable molecular mobility of alloys, in virtue of which certain combinations of the constituents of a molten alloy become segregated from the mass, the homogeneous character of which is thereby destroyed. Thus, to take an extreme case, an alloy containing 77·33 per cent of silver, and 22·67 per cent of copper was cast in a cubical mould of 42 millimetres. A portion cut from the centre of the mass gave on assay 78·318 per cent of silver, while a portion cut from one of the angles was found to contain only 77·015 per cent of silver, showing a difference of 13·05 milliemes. Levol proved that it is only the alloy containing 71·893 per cent of silver and 28·107 per cent of copper which is absolutely homogeneous. It is interesting to note that there is, as far as I am aware, no monetary alloy having this composition; the nearest, the Swedish standard, containing 75·00 per cent of silver. He also finds that while the alloy containing 71·89 per cent of silver is homogeneous, in all alloys containing more silver than this amount the centre of the solidified mass is richer than the exterior; on the other hand, in alloys of fineness lower than 71·89, the centre contains less silver than the external portions. It is of great interest to observe the results of an experiment on a cubical mass of 42 millimetres, similar in composition to the British standard. The maximum difference between the centre and one edge was 9·95 per mille, while the mean variation between the composition of pieces taken from different parts of the mass was 2·96 per mille. Fortunately the gold-copper alloys employed in the British and other European Mints present a very slight variation in composition, due to molecular arrangement. I may remark that the copper in the standard gold alloy has a singular tendency to oxidise even to the centre of the mass, a phenomenon in which I cannot but think the actual occlusion of oxygen plays an important part.

"Without entering into further details, I would draw the following practical conclusions:—

"1. The molecular re-arrangement must take place during the solidification of the mass, and the thin bars, therefore, which are in use on the Continent possess a decided advantage over the thicker ones in use in the British Mint, from the fact that they are more rapidly cooled.

"2. The continental method of taking the portion of metal for assay should be adopted in the British Mint, the composition of the alloy being much more accurately represented by a portion from the recently stirred fluid mass, than a test piece cut from the end of a solidified bar.

"3. Although the defects due to the non-homogeneous character of the alloy are to some extent modified by rolling the bars, still the centre of a fillet of standard silver often differs by at least 2·3 per mille from the edges, and a five-franc piece, therefore, will vary in composition in different parts of the coin, the centre being the richest; or if (as is the case with the shilling) two coins are cut in the width of a fillet, the portion containing most silver will be near one edge of each coin.

"In England the method of cutting a piece from a silver coin for assay may not give a correct result, as a segment, or even a strip cut through a coin, may fail to indicate its composition with absolute accuracy. M. Stas, the head of the Belgian Mint, introduced the following accurate method. Small cylindrical or square portions are punched from various parts of the coin, the number and exact position of such pieces having been determined for each denomination of coin by calculations founded on an elaborate series of assays. I am indebted to M. Arthur Nyst, assayer of the Belgian Mint, for the results of experiments on the coins of that country."

The subjects of loss, treatment of sweep, and verification, being of considerable interest to chemists are quoted at length.

"*Loss.*—The metallurgical treatment of the precious metals is attended with unavoidable loss.

"In the English Mint the amount of loss on gold melting is considered to be 0·173 per mille, or one grain on the Troy pound. The apparent loss on silver melting under the new arrangements of the melting house is two grains on the Troy pound, or 0·346 per mille, much of the metal being recoverable from sweep. I have experienced great difficulty in obtaining accurate information with regard to the amount of loss that accrues during the manipulation of gold and silver in various European Mints. The following details were furnished to me:—

"In Mint A there is allowance of one per mille for loss on gold and 2‡ for silver.

"In Mint B, a loss of one per mille for gold was considered to be a low estimate.

"In Mint C, the average loss was 0·7 per mille for gold, and 2·5 for silver.

"In Mint D, the loss on gold was stated to vary from 0·2 to 0·4 per mille.

"The officers of the English Mint consider that the loss on the gold coinage will, for the future, certainly not exceed £200 on a coinage of one million, or 0·2 per mille.

"*Cause of Loss.*—The loss which arises from melting gold may be caused by volatilisation in combination with copper or other more volatile metals. I have stated above that the loss on gold melting has been found to be 0·173 per mille; but it has been experimentally proved by melting ingots, that there is a loss of 0·054 per mille due to foreign matters, weighed as alloy before the fusion. The precious metal actually volatilised may be arrested by condensation. This point has received much attention in the Roman Mint, where the flues of the gold-melting furnaces have been placed in communication with condensing chambers of simple construction, the adoption of which has been attended with very satisfactory results.

"I have already alluded, under the head of blanching, to a source of loss on melting worn coins. I now beg to call your attention to a point of much interest, experimentally developed by Dr. van Riemsdijk, who finds that the silver coins of five countries contain oxide of copper, in amounts varying from 0·3 to 2 per mille. On re-melting old coin and scissel, there is a loss in weight, often of as much as 0·25 per mille, due to the reduction of oxide of copper to metallic copper by the charcoal under which the alloy is melted. Although I have no accurate information with regard to the loss on gold coins and scissel, still I am convinced that, with the present methods of annealing practised in the British Mint, the amount of loss arising from the above cause must be very sensible. It is true that the loss in weight is attended by a corresponding elevation of standard, but it nevertheless remains a distinct element of 'waste.'

"*Treatment of 'Sweep.'*—Under the term 'sweep' is comprised dust collected from the floors, ashes, dust from

flues, scrapings from crucibles, and residues generally which are likely to contain precious metal. At present it is the practice in the Mint in this country to grind the old crucibles, and to sift the product with the rest of the sweep through a sieve of 400 meshes to the square inch, the finer portions being sold to the highest bidder. In most European Mints the precious metal is extracted from the residues by the amalgamation process. I propose to make experiments with Mr. Crookes's sodium amalgamation process. I am not prepared to state that the extraction of the precious metal from a comparatively small quantity of sweep would be a source of actual profit, but I recommend that the operation should be undertaken by the Mint itself; for, as the gold and silver would be recovered in the metallic state, any deficiency would be absolute loss, and the amount of such loss would afford an intelligible indication of the degree of perfection attained in the conduct of the various operations.

"*Verification, or Assaying.*—The method of gold assaying at the Mint in this country is identical with the process agreed upon at the Mint conference held at Vienna in 1857, and it is not possible to suggest any improvement in this respect, the excellent platinum apparatus of Messrs. Johnson and Matthey having been recently introduced into the establishment. In England, muffles heated with anthracite are employed, while at Berlin solid fuel is replaced by gas. I have no practical experience of muffles heated by gas, but the advocates of the method consider the temperature to be more completely under control.

"The method of silver assaying by cupellation is still employed in the British Mint, and, before proceeding to consider the practice of other European Mints, I may state that the chief objection to the method is the number of 'check assays' on standards of known composition rendered necessary by the variability of the temperature during the operation. In all other Mints the silver assay by cupellation has been superseded by the volumetrical method devised by Gay Lussac. The results are not accurate if the alloy contains mercury, as this metal interferes with the reaction. The process cannot be conveniently applied to silver alloys the composition of which is not approximately known, but this objection does not apply to the practice at the Mint, as trade assay reports are in all cases furnished with the ingots. The usual mode of conducting the volumetrical process is attended by certain errors arising from the solubility of the chloride of silver in the solution employed as a precipitant, and from the liberation of chlorine by the conversion of chloride of silver into subchloride by the action of light. These points have been investigated by M. Stas, and after a research detailed with the elaborate care so characteristic of his work, he finds extreme accuracy may be attained by substituting hydrobromic acid for the hydrochloric acid or chloride of sodium ordinarily employed. One great advantage of the modification of the process consists in the last traces of the silver being rapidly precipitated, and more easily distinguished than is the case with chloride of silver. Indeed, by employing an extremely accurate drop apparatus, the possibility is asserted of distinguishing the precipitate produced by a single drop of the decimal solution, or, in other words, the presence of the half of one-tenth of a milligramme (0·00005 grm.) of silver. The decomposing action of light is avoided in the Mints of Utrecht and Brussels by means of windows of yellow glass. I therefore suggest that experiments should be made in the Mint, to test side by side the cupellation and volumetrical methods, and that at the same time the manipulatory precautions suggested by M. Stas should be adopted.

"There is one other method of assaying practised in India; it consists in weighing the precipitated chloride of silver. The results obtained are very accurate, but the process entails much labour and delay, and I am not aware of its having been adopted in any European Mint."

While we have thus largely quoted from this excellent Parliamentary paper, we advise those of our readers who may be inclined to study this subject to read the whole of these fifty pages, which are obtainable for the very moderate sum of 3½d.

The authors unanimously bear testimony to the very courteous and polite reception accorded to them everywhere on the Continent.

CORRESPONDENCE.

MAGNETISM AND DIAMAGNETISM.

To the Editor of the Chemical News.

It may interest some of your readers if I mention an experiment I tried the other day, revealing a fact which I have not seen mentioned elsewhere; more especially as it bears on an important magnetic law.

I took two magnets of about equal weight and power, and compared the attraction they had for one another with that which each had for a piece of soft iron. I found that, when in contact, the attraction for each other was the same as that of either for the soft iron; but at a short distance the former was double of the latter. The question which this result bears upon is this—when one pole of a magnet is in contact with a piece of iron or steel, does it produce in it a pole of an opposite name, or only of the same name? At a short distance, there is no doubt that it produces, in the part nearest itself, a pole of an opposite name, and that, as the distance diminishes, the two neutral lines, one between the magnet and the iron and the other in the iron itself, draw nearer and nearer to the point of contact. When there is actual contact, do these neutral lines vanish? All our text-books assume the negative. Du Moncel, in 1858, asserted that this was a mistake; and when there is actual contact, he declares there is no trace of any neutral line or of a pole of opposite name to the pole of the magnet. From such experiments as I have been able to try, I should say that if the pole of the magnet and the end of the piece of iron be exactly the same size, and perfectly ground so as to come into very close contact, the neutral lines disappear; but where this is not the case, the neutral lines disappear only at those particular points which are in actual contact, and that in those which are at a short distance there is a real double polarity. The experiment is very difficult to try; for if steel-filings be used, which is the simplest plan, it is almost impossible to prevent some particles from springing between the magnet and iron and so preventing perfect contact; and if we make an examination with a steel needle, the superior attraction of the magnet gives an appearance of repulsion between the needle and the points of the iron which are near to the magnet. But I think this appearance is deceptive; for the nearer the end of the needle is brought the less the repulsion, and when in contact there is an attraction; but again, this is sometimes produced by the reversal of the magnetism of the needle. Of course a single grain of dust of any kind between the magnet and the iron vitiates the experiment. At any rate, the little pictures given in our text-books (take, for instance, Ganot's "Physics," and Watts's "Chemical Dictionary") are drawn from mere fancy, and give an entirely erroneous idea of the facts as they are in nature.

While I am on this subject, let me observe that all the phenomena of diamagnetism, so-called, are perfectly explicable on old and well-known principles, without introducing any new property of matter. The distinction between magnetic and non-magnetic bodies, or rather between bodies more or less magnetic, is well known. Now when a body of small or no magnetic power is placed between the poles of a strong electro-magnetic, if it approaches either pole a voltaic current must be produced by this approach, parallel to and in an opposite direction to

the currents circulating round the pole of the magnet, and, therefore, a repulsion takes place. At the same time, as it was receding from the opposite pole, a current was formed parallel to and in the same direction as that circulating round this second pole, and therefore attraction takes place. Therefore, if the body, placed ever so little equatorially, approaches either pole, a current is formed, passing in a circuit round the length of the body, repelling it from this pole and attracting it to the other. These forces are in equilibrium only when the body stands equatorially at equal distances from each pole. In crystalline bodies the conducting power in different directions is modified by the axes and cleavage of the crystal. Hence these bodies comport themselves differently from non-crystalline bodies. *And here lies the whole mystery of diamagnetism.* When the specific conductibility of a body exceeds its specific magnetic power, it is diamagnetic; when otherwise, magnetic.

As it is very desirable to simplify, as much as possible, and diminish the number of natural laws, this simple and adequate explanation of the phenomena, which I have never seen given elsewhere, seems not unimportant.—I am, &c.,

H. Highton.

Putney, December 22nd, 1870.

PS. In order to explain quite thoroughly from first to last the action of *diamagnetism* we must go a little deeper. Suppose any conducting body placed between the poles of an electro-magnet; the circuit is then closed; what is the consequence? According to well-known laws, two temporary currents are produced along the two longitudinal surfaces of the conductor which are nearest the poles of the magnet, both currents moving in the same direction, and both repelling the conductor from the poles of the magnet. These currents would form a circuit by returning along the interior longitudinal axis of the conductor. The conductor thus repelled from each pole takes up its equatorial position between the poles of the magnet at an equal distance from each; and is then kept there by the action described above, which prevents it approaching either pole. Let me add that all currents act more or less in pulsations; that, as each pulsation swells, currents are produced, repelling any body from each pole; as each decreases, currents are produced, attracting to each pole equally; thus, again, the equatorial position is the only position of equilibrium.—H. H.

SOLUBILITY OF TIN IN NITRIC ACID.

To the Editor of the Chemical News.

Sir,—Nearly eleven years ago, I observed that metallic tin was soluble in moderately dilute nitric acid at or near the freezing-point of water, and that this solution appeared to decompose with production of metastannic acid at temperatures above 41° F., or even at a lower degree if exposed to bright light.

I spoke of this tin solution in the year 1860, to my friend the late Mr. Frank B. Fowler, but he then expressed himself as having heard of the fact being published previously. Mr. Fowler afterwards invited me to go and see "some crystals obtained *in vacuo* from our tin solution," but his illness upset the arrangement.—I am, &c.,

Wentworth L. Scott.

THE SPECTROSCOPE IN WATER-ANALYSIS.

To the Editor of the Chemical News.

Sir,—In studying the best modes of rapidly detecting and localising the sewage contamination of a particular water-supply, I was led to devise a plan which, so far as I can tell at present, promises to be of great service. I will briefly illustrate its nature and use by an example.

On one side of a crowded court several cases of typhoid fever had been developed. The water used by the inhabitants of these houses was drawn from a rather shallow well, and was highly charged with various unoxidised compounds of nitrogen. It was suspected that the drain from a public urinal might be defective and have allowed egress of its contents into the well. This notion was confirmed by the quantity of common salt contained in the well-water, namely, seven times as much as that in the normal waters of the neighbourhood. But it received an absolute proof in the following novel manner. Two grammes of a *lithium* salt were introduced into the urinal. Two hours afterwards lithium was detected spectroscopically in a litre of the well-water before alluded to. A quantity of this water, ten times as large, showed no trace of lithium previously.

It is needless to point out the wide adaptability of this method to the detection of the particular source or sources of contamination in a water. Other metallic salts might be used, but those of lithium commend themselves on account of their harmlessness and ease of detection. They do not seem, moreover, to be much absorbed by most soils and gravels, and so are not stopped in their way to the wells.

Further experiments in the direction indicated in this brief note are in progress.—I am, &c.,

A. H. Church.

Royal Agricultural College, Cirencester.
December 22, 1870.

MISCELLANEOUS.

University of London.—The following is a list of the Candidates who have passed the recent examination:—*Second B.Sc. Examination* (*Examination for Honours*).—Chemistry.—First Class. Robert Routledge (disqualified by age for Scholarship), Owen's College. Henry Newell Martin, Christ's, Cambridge, and University College, London. Second Class. Frank Clowes, College of Chemistry and private study.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Corporation Buildings, on Monday evening, the 5th inst., at eight o'clock. W. R. Hutton, Esq., in the chair. Dr. Wallace, F.R.S.E., President of the Section, and Gas Examiner for the City of Glasgow, delivered a lecture "On the Illuminating Power and Impurities of Coal-Gas." At the following meeting, held on the evening of the 19th inst., Mr. Robert R. Tatlock, F.R.S.E., read a paper "*On Some Sources of Error in Volumetric Analysis*," an abstract of which will appear in our next.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

The American Journal of Science and Arts, No. 150, November, 1870.

This number opens with the announcement that a third series will be commenced on the 1st of January, 1871. This series will be issued in monthly numbers of seventy-six pages, making two volumes a year of 456 pages each. Subscription for the year, 6 dollars or 50 cents a number.

Examination of the Bessemer Flame with Coloured Glasses and with the Spectroscope.—J. M. Silliman.—This important paper is reproduced *in extenso*.

A Simple Method of Measuring Electrical Conductivities by means of Two Equal and Opposed Magneto-Electric Currents or Waves.—Dr. A. M. Mayer.—This paper is illustrated with a series of woodcuts, and therefore is not well suited for abstraction.

Account of the Fall of a Meteoric Stone in Stewart County, Georgia, U.S.—Dr. J. E. Willet.—It appears, from the detailed account given in this paper, that on October 6, 1869, about 11·30 a.m., a meteorite fell from the sky, which was perfectly clear and cloudless at the time. The fall of the stone was attended by a very strong explosion. The stone was recovered almost immediately after it reached the earth; it gave off a peculiar odour; weighed 12¾ ozs.; its colour within very like light-coloured granite; externally, it was covered with a smooth, almost black-coloured shell, a little thicker than common letter-paper; its shape was an irregular, seven-sided figure, its longest side being about 2¾ inches long.

Description and Analysis of a Meteoric Stone that Fell in Stewart County, Georgia, U.S., on the 6th of October, 1869.—J. Lawrence Smith.—The author, on more closely investigating the stone alluded to in the foregoing paragraph, found its specific gravity to be 3·65. The fractured surface has a greyish aspect, and, when examined with a magnifying glass, exhibits numerous greenish globules, with a whitish granular material between. Through the mass are dark particles consisting principally of nickeliferous iron, with some pyrites, and a few specks of chrome-iron. The nodules are sometimes 3 or more m.m. in diameter, and of an obscure, fibrous, crystalline structure; they have a dirty bottle-green colour, a greasy aspect when broken, and are more or less opaque. Some of these nodules were separated in a tolerably pure state, and amounted to 121 m.m. On analysis it was found to contain—Silica, 48·62; alumina, 8·05; protoxide of iron, 11·21; magnesia, 30·18;—total, 98·06. Nickeliferous iron constitutes about 7 per cent of the mass; and a portion thereof, separated in as pure a state as possible, yielded, on analysis—Iron, 86·92; nickel, 12·01; cobalt, 0·75. The part of the stone soluble in acid, amounting to 58·05 per cent, was found to consist, in 100 parts, of—Silica, 41·08; alumina, 0·32; protoxide of iron, 18·45; magnesia, 41·06. The portion insoluble in acid, amounting to 41·95 per cent, was found to consist, in 100 parts, of—Silica, 56·03; alumina, 5·89; protoxide of iron, 15·21; magnesia, 21·00; lime, 0·10; soda, with a little potassa and lithia, 2·97. The soluble part is olivine, while the insoluble is bronzite, with a little albite or oligoclase. Chrome-iron was detected by fusing some of the stony part of the meteorite with carbonate of soda and a little nitrate of potassa, and separating in the usual way; the quantity was quite minute. The composition of the stone, as made out, would be, in 100 parts—Nickeliferous iron, 7·0; magnetic pyrites, 6·10; bronzite or hornblende, olivine, albite or oligloclase, and chrome-iron, together, 86·90.

Some Practical Remarks on the Use of Flame-Heat in the Chemical Laboratory, Especially that from Burning Gas, without the Aid of a Blast.—J. Lawrence Smith.—This essay is full of practical value; but, as the woodcuts are absolutely required for the subject to be properly understood, we cannot give an abstract.

Connection between Terrestrial Temperature and Solar Spots.—C. Abbe.—A valuable contribution to our knowledge on this subject

Oxycalcium Light, as Applied to Photo-Micrography.—Lieutenant-Colonel J. J. Woodward.

Farmer's Theorem Discussed.—F. E. Stimpson.—This paper, and the following—

Note on Mr. Stimpson's Paper on Farmer's Theorem—B. Silliman—Bear upon the paper "On the Relation between the Intensity of the Light Produced from the Combustion of Illuminating Gas and the Volume of Gas Consumed," written by the last-named author.

Determination of the Photometric Power of a Rich Gas by Dilution with a Poor Gas of Known Value: the "Method of Mixtures."—B. Silliman.—The conclusions arrived at by the eminent author as the result of a series of experiments made with great care at the Manhattan Gas Company's Works, New York, are—(1) That in all illuminating gas we have a substratum of non-luminous gas holding in solution a variable volume of luminous gas (olefines). (2) That, when a gas is too rich in illuminants to permit of accurate photometric admeasurement by the usual standards of intensity, it may be diluted, with a poor gas of known value and volume, to such a standard as is consistent with the accurate employment of the usual photometric apparatus, its true value being then calculated from known values employed.

The Hailstorm of the 20th of June, 1870.—Rev. H. C. Hovey.—An interesting description of this extraordinary phenomenon, as witnessed by the author at Northampton, Mass., U.S.. The paper is illustrated with several woodcuts exhibiting the structure and shape of the hailstones.

Photograph of a Solar Prominence.—Prof. C. A. Young.

Geological Explorations in China.—Baron von Richtenhofen.—This paper is a letter to Professor J. D. Whitney, dated from Pekin, August 20th, 1869, and containing a series of interesting details relating to the geology of the Celestial Empire.

Chemistry of the Bessemer Process.—Lieut. C. E. Dutton, U.S.A.—Reserved for full reproduction.

Earthquake of the 20th of October, 1870.—The brief report of some observations made on this phenomenon, which occurred in a portion of the States and adjacent Canada territories.

Zeitschrift für Chemie von Beilstein, No. 18, 1870.

Volatile Acids Contained in Croton Oil.—A. Geuther and O. Frœlich.—The authors saponified a large quantity of croton oil with a strong caustic soda lye. They removed the soap from the mother liquor, and after having saturated this alkaline fluid with sulphuric acid in excess, submitted the resulting liquid to distillation in a copper vessel; the aqueous distillate was neutralised with soda, evaporated to a small bulk, and again treated with sulphuric acid in excess. The crude fatty acids thus obtained were rectified, and by this process four liquids of varying boiling-points were obtained, viz.: (*a*) boiling at from 115° to 160°; (*b*) at from 160° to 190°; (*c*) at from 190° to 205°; (*d*) at from 205° to 270°. The first portion of these fluids was found to contain butyric and acetic, but no propionic acids. In the second portion the authors expected to find crude crotonic acid, and also quartenylic acid, which boils at about 171·9°; but, as evidenced by the following results of organic elementary analysis—$C_5H_{10}O_2$, in 100 parts, 58·8 carbon; 9·8 hydrogen; 31·4 oxygen; and $C_4H_8O_2$, in 100 parts—carbon, 55·8; hydrogen, 7·0; oxygen, 37·2—these figures show that acids belonging to the oleic acid series are not present in this fluid. The third portion, which crystallises on cooling, was found to contain an acid resembling angelica acid, a solid substance exhibiting colourless rhombic-shaped crystals, fusing at 64°, boiling at 201°. This body has been called tiglinic acid by the authors, for although its formula is the same as that of angelica acid, that acid is distinguished from the body here alluded to by its fusing and boiling points, which are respectively 45° and 190°. The authors further state that it is possible that this tiglinic acid (the name is derived from croton-tiglium) is identical with the methylcrotonic acid of Dr. Frankland and Mr. Duppa (*Ann. Ch. Pharm.* 136, 10). This supposition is strengthened by the fact that the ethyl ether of the tiglinic acid, $C_5H_7O_2.C_2H_5$, boils at the same temperature (156°), as found for the methylcrotonic acid ether by the *savants* just named, while the specific gravity also agrees (0·926 at 21°). The ethyl ether of tiglinic acid, moreover, corresponds in its properties with those of the methyl crotonic ether, being a colourless insoluble fluid, transparent in water, exhibiting a peculiarly aromatic smell. Tiglinate of barium, $C_5H_7O_2.Ba'+5HO_2$, a salt crystallising in a small acicular shape, readily soluble in water. Tiglinate of silver, $(C_5H_7O_2)2Ag''$), obtained by precipitating the solution of the baryta salt, is a white coloured crystalline powder, very little acted upon by the sunlight. The fourth portion of the fractional distillation was only obtained in small quantity, and was found to contain, as far as tests and analysis admit of certainty, capronic, or œnanthylic or pyroterebinic acid. The authors conclude that their researches on this subject entirely eclipse those of Dr. Schlippe, who has (*Ann. Ch. Pharm.* 105, 49) erroneously stated that the volatile acids of croton oil should contain crotonic acid, $C_4H_6O_2$, and angelica acid.

Some Derivatives Obtained from Normal Propylic Alcohol.—Dr. C. Schmidt.—The following compounds are treated of in this paper: Bromide of propyl, C_3H_7Br, boils at 71·5°; iodide of propyl, C_3H_7I, boils at from 100° to 102°; formic acid propyl ether, prepared by the reaction of formiate of soda upon the bromide of propyl, formula $C_3H_7CHO_2$, boils at 74°; sulphocyanide of propyl, $C_3H_7.S.CN$, an oily, disagreeable smelling liquid, boiling at 163°, not belonging to mustard oil (essential) series. Propyl sulphuric acid yields a baryta salt. Formula: $(C_3H_7SO_4)_2+3H_2O$; propylamine, $C_3H_7NH_2$, a fluid boiling at from 78° to 80°. The hydrochloride of this base is a very hygroscopic salt; the platinum salt, $(C_3H_7.NH_2.HCl)_2PtCl_4$, is bright yellow coloured; the sulphate, $(C_3H_7.NH_2)_2SO_4$, crystallises difficultly; cyanide of propyl, C_3H_7NC, boils at from 95° to 100°, and is a very fœtid smelling liquid.

Bayerisches Industrie und Gewerbe Blatt, September and October, 1870.

Review of the Mining, Mineral, and Salt Production in the Kingdom of Bavaria for the year 1868.—A valuable statistical account of the mining and metallurgical industry of the country alluded to. The particulars extend not only to the salt production, but also to that of graphite, porcelain, clay, gypsum, emery, alum, pyrites, and other minerals.

Water Supplied to the Towns of Kaiserslautern, Zweibrücken, Amberg, Bamberg, Bayreuth, Hof, Fürth, Erlangen, Rothenburg-on-the-Tauber, Nördlingen, Memmingen, and Neuburg-on-the-Danube.—A. Wagner.—This exhaustive essay was made at the suggestion of the Bavarian Ministry for Trade and Public Works, and contains the following particulars about each of the towns above named, number of inhabitants, physical geography, geology of the soil upon which the towns are situated, hydrography, means and methods of supply of water, physical properties, and full analysis of the waters. the author taking as basis the quantity of total solid residue contained in 1 litre of each of the 64 samples of water, classifies the water into seven classes, the first containing from 0·0 to 0·3 grm. of total solid residue, and the last from 2·0 to more grms. Only 4·7 per cent of the waters analysed belong to the first class, while to classes 6 and 7 belong respectively 14 and 11 per cent, both of these kinds of water being considered unfit for use for domestic purposes. The contents of this paper are chiefly of local importance, but the researches prove the truth of the ancient maxim, *tales sunt aquæ quales terræ per quas fluunt.*

Effect of Wind and Weather as Affecting the Draught of Chimneys.—Dr. T. Huber.

Gabbro Mass.—J. von Schwarz.—Under this name the author prepares a plastic mass, consisting of two-thirds of steatite (chiefly a silicate of magnesia), one-third of pottery clay, and 1-16th of soda. The steatite is first ground with water and afterwards intimately mixed with the other ingredients. In a semi-dry state this mixture may be turned on the lathe the same as wood, but is chiefly used for making an excellent kind of pottery ware. When intended to be used instead of wood the mass may be coloured with aniline or other colouring matters.

NOTES AND QUERIES.

Manufacture of Kelp.—(Reply to "A Student").—Consult Wagner's large work on "Chemical Technology," vol. v.; "Muspratt's Dictionary," and "Ure's Dictionary of Arts, Manufactures, &c.," all of which you can inspect at the library of the Commissioners of Patents.

Aniline Colours.—(Reply to "Stainer").—Your best plan is to consult the work on the "Aniline Colours," edited by the Editor of this journal, and published by Messrs. Longmans and Co., and also Schützenberger's work referred to on p. 312, No. 578 of this paper. As regards the alumina it is, in all probability, the amorphous and gelatinous oxide of aluminium which is meant by Mr. Perkin. Tannic acid forms insoluble compounds (lakes) with several of the so-called aniline colours.

Turkey-Red.—(Reply to "Magenta.")—Some years ago a brief account of some experiments made with aurine were published in our pages. By referring to these you will probably meet with what you want but Turkey-red is a misnomer, for it only applies to a speciality of madder dyeing; the aurine colours are not fast, but very beautiful. Rosolic acid, when dissolved in alcohol or acetic acid, is precipitated from these solutions by water in the shape of a deep orange-red coloured flocculent precipitate, and with baryta and lime compounds it forms insoluble crimson-coloured combinations.

Separation of Tarry Matter from Gas-Water. — (Reply to "Gas Engineer").—If the gas liquor be first neutralised with oil of vitriol or other acid (by which an additional quantity of tarry matter held in solution by the alkaline ammoniacal compounds therein, will be set free), it should be agitated in suitable close vessels with successive small quantities of bisulphide of carbon, which can be drawn off and re-distilled with very trifling loss, the tarry products also being saved. If, on the contrary, it is essential that the gas liquor be treated before neutralisation, it must be agitated under similar circumstances with any light form of naphthol or commercial benzine. I recommend both methods, but especially the first-named, from practical experience.—Wentworth L. Scott.

MEETINGS FOR THE WEEK.

Monday, Jan. 2nd.—Medical, 8.
Tuesday, 3rd.—Royal Institution, 3. Prof. Odling, on "Burning and Unburning." (Juvenile Lectures.)
—— Zoological, 9.
Thursday, 5th.—Royal Institution, 3. Prof. Odling, on "Burning and Unburning." (Juvenile Lectures.)
Friday, 6th.—Geologists' Association, 8.
Saturday, 7th.—Royal Institution, 3. Prof. Odling, on "Burning and Unburning." (Juvenile Lectures.)

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INDEX.

ABBE, C., connection between terrestrial temperature and solar spots, 323
Abel, F.A., F.R.S., committee on the chemical nature of cast-iron, 161
Aberration, minimum of prismatic, 227
Absorption of light, 240
  spectrum of fluid hyponitric acid, 240
Acetic acid, anhydrous, bromated derivatives of, 70
  phosphate of lime in, 178
  vapour density of, 154, 202
Acetyl-derivatives of ammonia, 312
Acid-oxalates of potassium, ammonium, and sodium, 14
Acids, volatile, contained in croton oil, 325
Aconite alkaloids, 216
Acoustical attraction and repulsion, 71, 191
Acoustics, 96, 227
Acridine, 192
Aëronautics, abridgments of specifications relating to, 44
Adalbert Iron Works, description of, 240
Ador, E., on phthalyl, 59
  radical of phthalic acid, 108
  and A. Oppenheim, sulphobenzoic acid, 213
Agassiz, L., bottom of the Atlantic Ocean, 47
Agoniada and agonidine, 84
Air of schoolrooms, carbonic acid in, 83
  oscillation of in pipes of different shape, 35
  pollution by chemical works, 27, 37
  specific heat of under pressure, 227
Albumen, 62, 190
  compounds, 84
  of eggs, properties of, 168
Alcohol, 71
  and starch, 192
  and water, density and freezing-point of mixtures of, 96
  normal propylic, conversion of allyl-alcohol into, 226
  derivatives obtained from, 323
  specific gravity of, 191
Aldehyd, conversion of chloral into by inverse substitution, 58
  polymeric modifications of, 47
Aldehyd-collidine, 202
Alizarine, 130, 168, 180
"Alkali Act, 1863; Sixth Annual Report" (review), 165
  metals, action of vapours of upon molten cast-iron, 48
  trade of Lancashire, 161
Alkalies in silicates, 84, 96
  contained in the mineral leucite, 13
Alkaloids, 192
  in plants of the Boragineæ, 262
Allain, M., manufacture of carbonate of baryta and artificially-made barytic stones, 72
Allen, A. H., determination of ferrous oxide in substances insoluble in acids, 57
Allen, J. F., alloys of copper, tin, zinc, and lead with manganese, 194
Alloy known as "Tiers Argent," 225
  of cobalt and manganese, 34
Alloys, analysis of, 48, 60
Allyl alcohol, conversion of into normal propylic alcohol, 226
  chloride of and hypochlorous acid, 36
  cyanide, 144
Allylic alcohol, 71
Alsberg, M., bromonitro- and bromamido-benzol, and position the hydrogen of benzol occupies, 84, 144
Alumina and magnesia, circumstances which favour the simultaneous precipitation of by ammonia, 4
Aluminium, electro-thermic properties of, 70
  hydrated chloride of as an antiseptic, 165
  in batteries, 228
  ethyl, 70
  weights, 187
Amagat, Dr., compressibility and expansion of gases, 34
Amalgam-hydrogenium, 96
Ambrosine, 71
Amides, action of phosgen on, 144
Amido bases, isomeric, from a hydrocarbon, 82
Amido-sulpho-phenol, 215
Amido-toluylen-sulpho acids, 214
Ammonia, acetyl derivatives of, 312
  action of on chloro-propionic and iodo-propionic acid, 287
  of upon chlorides of thionyl and selenium, 226
  and nickel, double chromate of protoxide of, 287
  anhydrous liquid, the solvent power of, 217
  gas, changes of colour of flowers in, 239
  machine, 47
  nitrate of, decomposition of, 168
  oxalate of, carbonic and alcoholic fermentation of, 34
  simultaneous precipitation of alumina and magnesia by, 4
Ammoniacal salts in the human organism, 21
  quantitative estimation of, 21
Ammonio-magnesium phosphate, estimation of phosphoric acid as, 227
Ammonium, potassium, and sodium, composition of acid-oxalates of, 14
  sulphocyanate of, 72
Amygdalin and amygdalinic acid, 83
Amylic alcohol, 106
Analysis, chemical, introduction of the principle of repetition into, 190
  elementary, 153
  of water of two mineral springs near Cairo, 144
  quantitative, new method of, 275
Analysts' fees, 11
Analytical processes, new, 190, 229
Andrian, F. von, geological studies concerning the Orient, 202
Aniline, action of chloride of sulphur on, 59
  black, dyeing, poisoning by, 191
  dyes, colouring power, 130
  or coal-tar colours, 17, 29, 40, 53, 64, 79, 92, 100, 312, 324
Animal charcoal, decolourising property of, 240
  improvements in manufacture of, 118
  kingdom, commensalism in, 120
Anthracen, 59, 83, 204, 216
  orange, 166
  derivatives, 37, 283
Anthrachinon, 130
  behaviour of to nascent hydrogen, 166
Antidote for snake poison, 179
Antimonic acid, 58
Antimonous sulphide, precipitation of from boiling solutions, 190, 259
Antimoniurets of copper, lead, nickel, silver, and iron, 83
Antimony oxide of from Algeria, 58
Antiseptic treatment of contagion, 195
Antiseptics, 166
Antozone and ozone, 35
Antwerp church tower, latitude of, 119
Aor, E., aldehyde-collidine, 202
Appolt, T., coke from non-caking coals, 191
Aqueous solutions of chemical compounds, specific heat of, 154
Arbutine, 35
Arènes of Paris, 24
Argostemma, new species of, 71
Aromatic glycol, 202
  hydrocarbons, 201
Arseniates and phosphates, 61
Arsenic and arsenious acid, ethers of, 96
  detection of in sulphuric and hydrochloric acids, 214
  metallic, method for purifying, 167
Arseniurets of copper, lead, nickel, silver, and iron, 83
Arsines and phosphines, action of chlorides of platinum, palladium, and gold upon, 58
Arson, M., Montyon prize, 46
Artesian wells, 168
Artificial light, new, 20
  stone and various kinds of silica, 195
Artus, J., bleaching ivory, 48
Arzberger, Dr., the electric clock, 155
Asbolan, 24
Asphyxia by charcoal vapour, 47
Atacamite, 261
Atomic volumes of solid compounds, 190
  weights, 24
Aurora, spectrum of, 225
Augite in minerals, 96
Ausset, M. D. D., death of, 72
Avogadro law, derivation of from mechanical theory of heat, 263
Azobenzol-sulphuric acid, 35
Azotoluol, 59
Azoxybenzide, action of pentabromide of phosphorus upon 144

BAEHR, G. F. W., results obtained by the mathematical study of the movements of the eye, 72
Baeyer, A., aldehyde-collidine, 202
  bases of the pyridine and chinolin series, 201
  euxanthon and euxanthinic acid, 201
  reduction of aromatic hydrocarbons by iodphosphonium, 201
  and A. Emmerling, reduction of isatine to indigo blue, 59
Baille, J., and A. Cornu, estimation of the absolute value of the intensity of terrestrial magnetism, 21
Balling, C. M., desilvering lead by zinc, 240
Ballo, M., action of nitric acid upon toluidine, 155
  naphthylamine, rosaniline, and brom-naphthaline, 130
Bardy, C., preparation of organic bases for colouring matters, 180
Barium chlorate, preparation of, 209
  platinate of, and hydrate of platinic acid, 47
Barometer, aneroid, for heights, 274
  weighing or balance, for compensating for temperature, 154
Barometrical oscillations, Mariotte's theory, 143
Barth, L., isomeric cresols, 83
  products of conversion of phenol, 288
Bathometer, new and improved, 311
Barringer, J., sorbinic acid and so-called para-sorbinic acid, 202
Baryta carbonate of and barytic stones, 72
Basicity (basicität) of acids, 59
Batalin, A., action of light upon the tissues of some mono- and di-cotyledonous plants, 154
Batteries, galvanic, 69
Battery, electrical, 95
  magnetic power of, 310
Bauer, A., alloy of lead with platinum, 263
  G., manufacture of steel types, 118
Baumhauer, Dr. E. H. von, etching, 96
  specific gravity of alcohol and alcohol and water, 71, 191
Béchamp, A., carbonic and alcoholic fermentation of acetate of soda and oxide of ammonia, 34
Becquerel, Professor, electric effects produced by contact of non-oxidisable metals with acids, neutral and saturated saline solutions, and on capillary affinity, 21

Becquerel, Prof., new researches on electro-capillary action: formation of crystallised oxychloride of copper and other analogous compounds, 58
A. C., and E., MM., observations of the underground temperature in the Jardin des Plantes, at Paris, from 1864 to 1870, 58
Beer, nitrogenous substances in, 179
chemical investigation, 108
for sea voyages, 144
from rice, 311
testing, 155
Beet-root juice, 72
sugar-works, 191
accident at, 108
Behr, A., quadri-phenylised ethylen, 214
Beilstein, F., chlorinated parachlorobenzoic acid, 202
isomerism in benzol series, 167
ortho-nitrotoluol, 202
recovering of iodine from substances which contain that element, 300
and A. Kuhlberg, ortho-nitrotoluol, 23
isomerism of the benzol series, 288
Bellanger, M., curvigraph, 60
Belohnbeck, A., beer from rice, 179
Bender, C., assay of cements, 262
analysis of water of two mineral springs near Cairo, 144
Beneden, M. van, commensalism in animal kingdom, 120
Benzilic acid, 167
Benzoates, metallic, contribution to the history of, 48
Benzoine, 167
Benzo-kreatine, 154
Benzol, 36, 48
bromonitro and bromamido, 84
position hydrogen occupies in, 144
series, isomerism in, 167, 288
Benzylic alcohol, action of chloride of cyanogen upon, 59
Berlin University statistics, 36
Bernard, C., asphyxia by charcoal vapour, 47
spectroscopical analysis of blood, 47
Bernays, J., manufacture of anthracen, 240
Berthelot, M., heat set free by mixing two liquids, 119
isomerism (allotropy) of the elements, 47
meta-naphthaline, 168
action of phosgen gas upon aromatic hydrocarbons, 48
synthesis of organic acids, 168
thermical researches on sulphur, 168
thermo-chemical researches on the sulphurets, 82
tribrom-hydrines, 21
Bethendorf, A., detection of arsenic in sulphuric and hydrochloric acids, sub-nitrate of bismuth, and antimonio-tartrate of potassa, 214
Beryllium platino-chloride, 263
Bessemer flame, examination of with coloured glasses and spectroscope, 313
process, spectroscope applied to, 44
Beswick, S., general doctrine of solutions, 25
and Swedenborg, 45
Bezold, W. von, analogy between some axioms of photometry and the doctrine of attraction, 107
electric discharges, 227, 239
electric dust figures, 35
Bichlorbenzol-chloride, 35
Bicoque insubmersible, 36
Birds, flying of, 130
Birnbaum, K., estimation of phosphoric acid in phosphorites, 287
Bischof, C., analysis of normal fire-clays, 179
pyrometric value of siliceous substances, 83
Bituminous shales, furnace for the distillation of, 47
Björklund, G. A., naphtha and ozokerite, 203
Blucher, Dr., test for guaiacum resin in jalap resin, 95
Black japan, 204, 216
Blast furnaces, hot, 179
Bloch, Dr., permeability of the skin for liquids, 144
Blomstrand, C. W., elementary bodies, 59
Blood, spectroscopical analysis of, 47
Blowpipe, Hare's, calorific power of, 207, 217
hot blast for, 103
Boe, A., latitude of tower of Antwerp Church, 119
Boeke, J. D., supposed formation of ozone during combustion, 57
Böttger, Dr., anthracen orange, 166
behaviour of anthrachinon to nascent hydrogen, 166
protochloride of copper when electrolytically decomposed, 167
coloured cements which harden rapidly, 167
depositing zinc on copper or brass, in wet way, 108
fluid for Plateau's equilibrium figures, 227
German beer bouquet, 179
glue, 179
preservation of thallium, 179
pulverised magnesium as a powerful reducing agent, 167
purifying metallic arsenic, 167
sensitive test for hyposulphites, 167
Bohemian diamond, test for, 96
Boiler incrustations, 72
Bois, V., prevention of boiler incrustations, 72
report upon an annular kiln, continuously working, for bricks and pottery, 72
Bolley, Dr. P., obituary, 104
washing and exhaustion of precipitates and other substances, 154
Bolton, H. C., rise and fall of defunct elements, 208
Boltzmann, Dr. L., force by moving gases, 95
reply to M. Most, 227
Bon, A., oven for smelting of metals and ores, 47
Bones, composition of, 106
Bontemps, M., manufacture of glass, 59
Borax beads, crystals in, 60
Borodin, H., isocaprin series, derivatives of, 95
Boron, haloid compounds of, 299
Bottomley, J., magnetic power of battery, 310
Boué, A., international scientific relations, 108
Bouillet, H., galvanical deposition of nickel, 22
Bourbouze, M., galvanometer, 94
Bourgoin, E., facts relating to chemical history of nitric acid, 48
Boussingault, M., estimation of graphite in carburetted iron, 35, 317
Brandt, F., researches concerning remains of mammalia in altaic cavern, 154
Brünning, Dr., zinc for desilverising lead, 311
Brass and copper, electro-deposition of upon iron, 1
zinc deposited on, 108
Breiting, Dr., carbonic acid in school-rooms, 83
Bretagne, C., arènes of Paris, and skeletons found there, 47
Brewing queries, 84, 96
Brick kilns, annular-shaped, 144
Brick making, ash and coke of gas-works for, 36
British Association, 117, 153
president's address, 133
Britton, J. B., on the burette for volumetric analysis, 66
determination of combined carbon in iron and steel, 101
Brom-benzol-sulphochloride, 144
Bromides, conversion of organic iodides into, 46
Bromhydrates of quinine and cinchonine, basic and neutral, 119
Bromine, 12
action upon dichlorhydrine, 167
on pyrotartaric acid, 23
and iodine production, 178
upon dichlorhydrine, 59
Brom-naphthaline, 130
Bromogallic acid, 130
Bromonitro-benzol-sulpho acid, 215
Bromo-phenol-sulpho acids, 288
Bromo-sulpho-toluol, 226
Bromo-toluol, sulpho-acids and sulpho-hydrates derived from, 144
Brosse and Lamfrey, MM., effervescing cyder, 34
Brown, J. C., chemical composition of bones of general paralytics, 206
Broun, M., new observations on variations of magnetic needle, 70
Browning, J., spectroscope for a laboratory, 229
spectroscope in which prisms are automatically adjusted for the minimum angle of deviation, 222
Bruckner, W. H., phosphate of lime in acetic acid, 178
Bruhn, H., cold produced by compression and expansion of air, 107
Buchanan, J. Y., action of pentachloride of phosphorus and hyposulphite of lead, 47
Buchner, L., earthen- and crockery-ware injurious to health, 154
Buckheim, Dr., alkaloids in plants of the Boraginææ, 262
Budde, E., Naumann's doctrine of the caloric of atoms and on Horstmann's criticism thereanent, 154
Buff, H. L., amido-toluylen-sulpho acids, 214
Buhe, A., application of coke as fuel for domestic purposes, and best construction of stoves for coke, 287
Building stones, preservation of, 205
Bullinger, J., manufacture of paper, and quality of paper made now compared with that made at more remote periods, 23
Bunsen, R., calorimetric researches, 240
filter pump, 12, 77
continuous water-bath, 42
Burette for volumetric analysis, 66
Burg, Dr., unlimited filtration of river water, 72
Burggrœve, Dr., application of thin sheet-lead instead of lint in wounds, 70
Burning coal-mine, utilising a, 94
Burnitz, C., black dyeing of horn without application of boiling heat, 154
Butlerow, A., action of phosgen on zinc methyl, 299
constitution of some non-saturated hydrocarbons, 299
Butters and fats, colouring, 180
Butyl-alcohol, 70

CÆSIUM, 312
and rubidium, 44
newly-discovered property belonging to, 25
Cæsium and rubidium salts, precipitation of with insoluble salts of lime, 150
Cahours, A. and H. Gal, action of chlorides of platinum, palladium, and gold upon phosphines and arsines, 58
some new derivatives from triethyl-phosphine, 22
Calcareous rock, 70
Calcimeter, Dr. Schiebler's, 75
Calcium, sulphide and sulphite of, 24, 36
Calico printing, madder for, 191
Calisaya bark from Java, 23
Callon, J., accident in beet-root sugar works, 108
Caloric of atoms, Naumann's doctrine and Horstmann's criticism, 154
Calorics, mechanical law applicable to, 240
Calorimeter of M. Favre, 107
Calorimetric researches, 240
Calvert, F. C., F.R.S., hygienic use of phenic acid, 82
quantity of pure nitrogen given off by organic nitrogenous substances, 82
substances preventing decomposition of organic substances, 281
Camphor group, 59, 83
pulverisation of, 275
Candles, economical, 95
Canizzaro, S., action of solid chloride of cyanogen upon benzylic alcohol, 59
Caoutchouc, effects of heat on elasticity of, 95
Cap, Dr., chemical nomenclature, 48
Capillary affinity, and on electric effects produced by contact of non-oxidisable metals with acids, neutral and saturated saline solutions, 21
Carbolic acid, 72, 84
Carbanilidic acid ether, 130
Carbon, chloride of, 70
incandescent, existence of two spectra produced by, 172
in iron, 311
sulphide of, decomposition of, 312
Carbonate of lime, alkalinity of, 85
estimation of in bone-black, 75
Carbonic acid apparatus, 23
decomposition by leaves of plants and trees, 35
and lime, apparatus for continuous preparation of by one operation, 94
in schoolrooms, 83
anhydride, combinations of with ammonia and water, 73, 85
ether, 192, 204
Carboxygen illumination, 107
Carburetted iron, estimation of graphite in, 317
Carius, L., action of bromine upon dichlorhydrine, 167
elementary analysis, 153
ether of sulphon acids, 312
formation of chloro-maleic acid from benzol, 178
isethionic acid, 312
specific gravity and expansion of the ethyl sulphon-acid, 312
Carles, M. P., decomposition of oxalic acid, 58, 168, 251
modifications which the alkaloids undergo under the influence of certain physical and mechanical agents, 251
quantitative estimation of alkaloids of cinchona and calisaya barks, 119
quantitative estimation of quinine in barks, 95
Carmichael, H., new method of quantitative analysis, 275
Carmine, composition of, 57
Caro, H., acridine, 192
Carstangen, E., action of chloride of chromic acid on hydrocarbons, 96
Casanova, J., fertility of soil in Corsica, 120

Casselmann, A., chemical researches on the fruit of the laurel-herb, 179, 228
Castor oil, behaviour of with petroleum and paraffin oils, 162
Cast-steel manufacture, 108
Catechu, quantity of tannic acid in, 216
Cazin, A., expansion of gases, 155
and Lucas, M.M., experimental researches on length of duration of electric spark, 21
Ccollpa, 202
Cech, O., value of continuously-acting diffusion apparatus in beetroot sugar works, 191
Cement, 36, 48, 262
and lime, 22
metamorphised in the water of Bayen de Luchon, 70
Cements, coloured, 167
Cerium compounds, 130
Cetyl-alcohol, 84
Chabassiere, J., bicoque insubmersible, 36
Chabrier, Dr., testing glue, 47
Chameroy, M., water-meter, 72
Champeaus and Pinard, M.M., furnace for distillation of bituminous shales, 47
Champion, P., manufacture of tam-tams, or gongs, and cymbals, 107
Chandler, W. H., production of iodine and bromine, 178
C. F., "Report on the Gas Nuisance in New York" (review), 44
hair tonics, washes, cosmetics, &c., 71
"Report on Quality of Kerosene Oil sold in New York" (review), 33
"Report on the Quality of the Milk Supply in New York" (review), 55
and W. B. Lewis, "Reports on the Water Supply in New York and Brooklyn" (review), 56
Chapelas-Coulvier-Gravier, M., meteorites of this year, 118
Chapelas, M., meteorology of the spring of the current year, 34
Chapman, E. T., reaction between water and nitrogen tetroxide, 311
Charcoal vapour, asphyxia by, 47
Chassin, Dr., earthquake in Mexico, 82
Chatard, T. M., treatment of gelatinous precipitates, 190, 246
Chautard, J., direction of induction currents obtained by aid of electrical discharges, 22
Chemical analysis, principle of repetition in, 269
appointments, 117
change, time needed for completion of, 193
equivalents, memoir on volumes of, 107
nomenclature, 48
problems, 310
Chemical Problems" (review), 298
Society, 213, 261, 283, 308
at Zurich, establishment of, 214
tables, according to theories of modern chemistry, 39, 163, 306
works, air pollution by, 27
Chemistry Chair, St. Bartholomew's Hospital, 299
in France, 191
new works on, 166
relation of to mineralogy, 263
schools of, 121
Chinolin and pyridine, 201
Chinons, 130
Chinon, molecular volume of, 83
Chiromys, place assigned to, 72
Chloral, 46
conversion into aldehyd by inverse substitution, 58
hydrate, chemical nature of, 46
Chloral hydrate, purification of, 23
Chloralum, 165
Chlor-bromine compounds, 84
Chlor-cyanhydrogen, non-existence of, 178
Chlorhydric acid, action of upon osseine, 107
Chloride of phosphorus, action of on pyruvic acid, 47
Chlorimetry, contributions to, 274
Chlorinated para-chlorobenzoic acid, 202
Chlorine, action of upon products of aldehyd, 214
gas, action of upon chloronaphthaline, 23
new method of obtaining, 157
manufacture, 145
Chloro-bromated compounds, organic, 22
Chloro-maleic acid from benzol, 178
Chloronaphthaline, action of chlorine gas upon, 23
Choc en Retour, phenomenon of, 118
Chojnacki, C., combination of ethylen with bromides of iron and platinum, 202
estimation of phosphoric acid in phosphorites, 227
Cholesterine in suint, 226
Chondrodite crystals, 154
Chromates, 35, 95
Chromic chloride, 83
Chromic oxide, chromate of, 288
Chutaux, M., electrical battery, 95
Church, A. H., mineralogical chemistry, 219
on cyclopic acid, 2
preservation of stone, 205, 224, 238
spectrum of aurora, 225
the spectroscope in water-analysis, 322
Church's "Laboratory Guide," 201
Chyle, fatty matters in, 191
Cinchona bark, 82
and calisaya barks, quantitative estimation of alkaloids in, 119
Cinchonin-chinoline, 202
Cinnamic acid, derivatives of, 35
Citric and tartaric acids estimating, 228
Claparède, Dr., origin of man, 120
Clarke, F. W., atomic volumes of solid compounds, 190
Claudet's process for extraction of silver, 184
Claus, A., action of bromine upon dichlorhydrine, 59
action of chloride of sulphur upon aniline, 59
Clausius, R., law applicable to calorics, 240
Claussen, E., vaccinine, a crystalline principle extracted from leaves of the cowberry, 71
Clays, fire-resisting properties of, 155
Clerget, M., report on apparatus for cleansing linen fabrics, 34
Climate of the Elsasz and the Vosges, 34
Clock, electric, 155
Coal, changes of in air, 22
formation, 72
in the Banate, 202
gaseous products of combustion of, 22
and smoke consumption, 24
Coal-gas, test for ammonia in, 120
sulphur in, 203, 307
Coal-tar or aniline colours, 17, 29, 40, 53, 64, 79, 92, 100, 324
distillation products, 213
Coals, prevention of spontaneous combustion of, 225
Cobalt and manganese alloy, 34
and nickel, quantitative estimation and separation of, 96
Coffee roasting, 179
Coke for domestic purposes, 287
from non-caking coals, 191
stoves, 287
Cold produced by compression and expansion of air, 107
produced by mechanical means, 203
Collision, 22
Collomb, E., glaciair striæ, 167
Colorimetric process, determination of combined carbon in iron and steel by, 101
Coloured glasses, examination of Bessemer flame with, and with spectroscope, 313
Columbite, 166
Combustion of organic germs, purification of air of hospitals by means of, 72
Comets, tails of, considered as electric phenomena, 294
Commaille, Dr., experiments made with salts of manganese, 267
precaution in use of phosphorus for absorption of oxygen from gaseous mixtures, 286
Compasses for drawing very minute circles, 179
Contagion, antiseptic treatment of, 195
Contejean, Ch., temperature at Poitiers, 82
Cooke, Prof., the cryophorus, &c., with Bunsen's pump, 12
"First Principles of Chemical Philosophy" (review), 10
Copper, alloy of, with manganese, 194
and brass, electro-deposition of, 1, 181
formation of crystallised oxychloride of, and other analogous compounds, 58
oxide and soda, double phosphate of, 288
protochloride, behaviour of, when electrolytically decomposed, 167
zinc deposited on, 108
Cornet and Briart, MM., note on natural pits of the coal measures, 119
Cornu, A., apparatus for measuring rotatory power, 168
and J. Baille, estimation of absolute value of the intensity of terrestrial magnetism, 21
Corrosion of iron water pipes, 23
Corsica, fertility of soil, 120
Cossa, Dr., preparation of aluminium-ethyl, 70
Cotton dressing, 214
Coumarin, new derivatives of, 85, 308
Crafts, J. M., ethers of the arsenic acids, 96, 167
Cresol, solid, 107
Cretaceous formations in exterior Alps, 108
Crith, 288
Crookes, W., F.R.S., "On the Manufacture of Beet-Root Sugar in England and Ireland," (review) 19
Croton oil, volatile acids contained in, 323
Crotonic acids, 84
Croullebois, M., indices of refraction of gases and vapours, and on measurement of the dispersion, 35
Crustaceæ, new species, 71
Cryophorus, &c., with Bunsen's pump, 12
Crystals, asterism in, 96
chondrodite, 154
of Greenockite, 154
Crystalline shape and chemical constitution of some organic compounds, 46, 215
Crystallites, 71
Crystallisation of a double salt, 181
Curcumine, 84, 154
Cuvier prize, 46
Curvigraph, 60
Cyanates, aromatic, 130, 287
Cyan-benzidine, 154
Cyan-chlorhydrine of ethyl-glycerine, 299
Cyanides, estimating, 204, 216
Cyanogen, action of chloride of upon benzylic alcohol, 59
chlorhydride of, 191
fluid, 130
Cyanogen, iodide of, action of on oil of turpentine, 107
liquefaction of, 113
Cycadææ, 71
"Cyclopædia of Quantitative Analysis" (review), 297
Cyclopic acid, 2
Cyder, effervescing, 34
Cymbals, tam-tams, or gongs, manufacture of, 107
Cymol, α, contributions to the history of, 47
Czumpelik, E., contribution to the history of α cymol, 47
derivatives of cuminic acid, 47
nitrobenzyl-cyanide and amidided benzyl-cyanide, 47

DA FONSECA BENEVIDES, F., apparatus arranged for demonstration of physical properties of vapours, 35
Dale, J. G., and E. Milner, an improved method of producing white pigments from lead, 45
Dall, W. H., pure scarlet, 190
Dalton on solutions, 25
Damboise-Benard, aspirating ventilator, 60
Darwin, Charles, value of labours of, 120
Daube, Dr., F. W., curcumine the pigment of turmeric root, 84
turmeric root, crystalline pigment of, 96
Davies, Dr. A. E., adulteration of milk, 61
Deacon, H., new method of obtaining chlorine, 157
De Bearmont, E., kinds of rocks met with during boring of tunnel through Western Alps between Modane and Bardonèche, 34
De Clermont, M., action of iodide of cyanogen upon oil of turpentine, 107
and Fontaine, MM., action of oxychloride of carbon on hydride of octyl, 48
De Fonvielle, W., Mariotte's theory of barometrical oscillation, 143
De Hauer, F., iron in Homer's period, 108
Dehérain, P. P., evaporation of water and the decomposition of carbolic acid by leaves of plants and trees, 35
De la Follye, M., the Arènes of Paris, 24
De Lagillardais, M., continuous syphon, and substitution of syphons for pumps in drainage works, &c., 60
Delanoue, J., the part gases play in volcanic eruptions, 119
De la Rive, A., influence exercised by magnetism on electric jets propagated in partially vacuous space, 22
magnetic rotatory polarisation of liquids, 58, 108
Delaunay, M., pyramids of Villejuif and Juvisy, 34
Delaurier, Dr., signals visible at great distances, 95
Delaurier's galvanic element, 94, 168
De Luca, S., researches on thermo-mineral water of the Solfatara, 95
Deluc's thermometer, 34
Deodorising oil, 228, 251
Der Mensbrugghe, G. van, superficial tension of liquids, as deduced from certain movements which take place on their surface, 35
Desnoyers, J., gaize, 34
De Saussure, H., the grotto of Scé, near Villeneuve, 60
Deville, H. Sainte-Claire, action of water upon iron, and of hydrogen upon oxide of iron, 34

Deville, H. Sainte-Claire, analysis of a schistose rock impregnated with carbonaceous matter, 69
observations on variations of temperature produced by mixture of two liquids, 22, 58
on calorimetrical methods of MM. Favre and Silbermann, 107
reply to criticism of M. Jamin in reference to a paper published in 1860, 58
Dextrine, 264
in raw sugar, 275
Diallyl, action of sulphuric acid on, 221
Diamagnetism and magnetism, 321
Diamido-benzoic acid, 83
Diamido-nitrophenylic acid from picric acid, 35
Diamonds, 69
Diastatic ferments, 167
Diamylen, 130
Dibenzoyl, 167
Dibenzyl at high temperature, 35
Dibrom-benzol, 214
Dichlorhydrine, action of bromine upon, 59, 167
Dicotyledonous plants, 71
Diesbach, M., peat, 168
Dieulafait, Dr., note on calcareous rock containing the *Terebratula diphya* in French Alps from Grenoble to Mediterranean, 70
Diffraction by the edges of the moon, 24
Diglycolamide nitrate of silver, 287
Dingler, E., beer for sea voyages, 144
enamelling of iron, 274
improved zundnadelgeweter, 179
manufactory of peas-pudding sausages at Berlin, 275
peat as fuel with coals, 312
spontaneous combustion of black-dyed silk, 144
Diphenyl, 60
Diphenyl-glycolic acid, 167
Diphenyl-oxide, 214
Dipseudo-propyl keton, 299
Disinfectant, Girondin, 118
Süvern, activity of the, 107
Dispersion of gases and vapours, 35
Dithiobenzoic and thihydrobenzoic acid, 23
Ditte, A., properties of iodic acid, 251
Divers, E., carbonic anhydride, combination of with ammonia and water 73, 85,
Dollfus, A., poisoning by dyeing aniline black, 191
Dobroslawine, Dr., fatty matters in chyle, 70, 191
Dombes, draining of the, 120
Dominique, M., decolouration and defecation of saccharine juices by means of phosphates and alumina, 47
Donders, F. C., movements of the eye, 71
Dove, Prof., reduction of the annual curves of temperature to the conditions upon which they are naturally based, 287
Drainage and the water supply, 203
Draper, H. N., behaviour of castor oil with petroleum and paraffin oils, 162
Drawings, plates, &c., copied readily and rapidly, 191
tracings, writings, &c., fixed, 191
Dreher, E., and R. Otto, behaviour of dibenzyl at high temperature, 35
conversion of thiophenol, 35
on mercuro-ditolyl, 35
Dry season of 1870, 168
Drying oil, 204
Dufour, L., flames, 96
C., notes relating to magnetic perturbations observed by De Saussure while sojourning on the Goldu Géant, 22
Dupré, A., on collision, 22
Durol, products of oxidation of, 226
Dusart, L., preparation of organic bases by artificial means for the manufacture of colouring matters, 180
Dust as a ferment, 197
Dutton, Lieut. C. E., chemistry of Bessemer process, 323
Dyas and coal formation in the Banate, 202
Dye material, new, 225
Dyes, amorphous silica for fixing, 83
and pigments, 130
Dyeing queries, 240

EARTH, edible, 217
Earthen- and crockery-ware, injurious to health, 154
Earthquake in Mexico, 82
of 20th of October, 1870, 323
Eau de Beauté de M. Bargasse, 179
Edible earth, 217
Edlund, E., electromotive force developed by contact of divers metals, 191
Edwards, A. M., itacolumnite, 111
specimens of soundings for the microscope, 99
Eghis, A., new mode of synthesis of naphthalin-carboxylic acid, 36
Egleston, T., diamonds, 69
Egyptian irons, 202
Ehrenberg, M., Cuvier prize, 46
Electric clock, 155
condensation, 22
currents, liquid conductors of, 191
discharges, 22, 227, 239
dust figures, 35
effects produced by the contact of non-oxidisable metals with acids, neutral and saturated saline solutions, and on capillary affinity, 21
light, useful applications of the, 119
phenomena and theories, 67, 105, 113, 151
spark, duration of, 21
Electrical conductivities, simple method of measuring by means of two equal and opposed magneto-electric currents or waves, 323
machine, Holtz's, 72, 155
Electricity, galvanic, liquid conductors of, 35
molecular theory and doctrine of, 227
Electro-capillary action, researches on, 58
Electro-deposition of copper and brass, 1, 181
Electro-dynamic law, 224, 238
Electro machine, diametral conductors of, 95
Electro-motive force by contact of divers metals, 191
of the electric light, 227
Electro-magnetic behaviour of discontinuous masses of iron, 144
Electro-magnetism, 190
Electro-magnets for lifting weights, 144
Electrophor, action of, 288
Electrophoric machine, 35
Elements, 59
defunct, rise and fall of, 208
"Eminent Men of the Day" (review), 11
Emmerling, A., and A. Baeyer, reduction of isatine to indigo-blue, 59
Emsmann, H., construction of a new and improved bathometer, 311
detaching paint and lacquer-work from tinned iron, 275
Enders, L., testing beer for presence of bitters of quassia, wormwood, and marsh-trefoil, 155
Engler, C., and O. Nasse, ozone and antozone, 35
Erbia, spectra of, 175
Erecting prism, 20
Erlenmeyer, E., earthen- and crockery-ware injurious to health, 154
Escher, E., methods of estimating manganese, 227
Estimation of graphite in carburetted iron, 317
Etching, 96
Ether, carbonic acid, and glycolic acid, 82
derivatives of the polyatomic alcohols and acids, 59, 154
ethyl-sulphon-acid, sp. gr. and expansion of, 312
of sulphon-acids, 312
Ethers in wine, 216, 228
of the arsenic acids, 167
Ethyl bases, separation of by oxalic ether, 214
Ethyl-naphthol-sulpho acids, 84
Ethylen and propylen, monobromated iodhydrates and chlorhydrates of, 251
bibromated, 21
combination of with bromides of iron and platinum, 202
haloid compounds of with hydriodic acid, 299
quadri-phenylised, 214
Eulenberg, H., addition of poisonous substances to bread, 215
injurious and poisonous action of tar colours, 107
"European Mints, Report of Deputy Master of the Mint on" (review), 318
Euxanthon and euxanthinic acid, 201
Evaporating at limited heat under pressure without a pump, 71
Excrements of Egyptian bats, 202
Extract of meat, 36
Eye movements, 71, 72
Eyes, fatigue to by artificial light, 95

FABRICS, mixed, discrimination of fibres in, 169
textile, mixture to render impermeable to water and incombustible, 47
Falk, F. A., oxamyl-sulphon acids, 312
Farmer, M. G., fusing iridosmine, 225
Favre, P. A., thermical researches on metallic character of alloy of palladium with hydrogenium, and on voltaic element wherein hydrogenium is the active metal, 58
Fats, fusion and solidification point of, 191
Fatty matters contained in the chyle of herbivorous animals, 70
Faust, A., final result of action of chlorine gas upon chloronaphthaline, 23
Faye, M., observations on some peculiarities of soil of Landes, 69
true chemical agents to be used as antiseptics, 166
Fees, analysts', 11
Feichtinger, G., nitrogenous substances in beer, 179
Santorin earth, 144
Fermentable matter of the river Newa, 203
Fermentation, 24, 34, 234, 241, 247, 254, 258, 263, 268, 292, 304, 316
Ferric oxide, estimation of ferrous oxide in presence of in siliceous minerals, 2
Ferrocyanides, critical review of, 168
Ferro-ilmenite, 166
Ferrous oxide, estimation of in presence of ferric oxide in siliceous minerals, 2
in substances insoluble in acids, 57
Filter-pump, Bunsen's, 77
steam, 163
Filtration of strong acids, 165
Finkelstein, B., action of zincethyl, 311
Fire alarm telegraph of New York City, 6
Fire-clays, analysis of, 179
Fireworks, Japanese, 203
manufacture, keeping, sale, and transport of, 263
"First Principles of Chemical Philosophy" (review), 10
Fischer, J. G., curious effects of lightning, 227
H., value of various oils used for machinery, 191
Fischer's salt and some analogous compounds, 8, 15, 26
Fittig, R., conversion of piperonylic acid into protocatechuic acid, 202
homologues of naphthaline, 167
sorbinic acid and so-called parasorbinic acid, 202
Flajolot, M., chemical composition of nadorite, 143
crystalline compounds of oxides of lead and antimony, and of oxide of lead and antimonic acid, from Province of Constantine, 58
Flame, Bessemer, examination of with coloured glasses and spectroscope, 313
Flames, acoustical studies on, 227
studying nature of, 96
temperature and heating power of, 102, 116
Fleischer, Dr. E., quantitative estimation and separation of cobalt and nickel, 96
Flints, 36
Flora of Japan, 71
Flückiger, F. A., aconite alkaloids, 216
purification of hydrate of chloral, 23
reactions of water-glass, 239, 263
Fluorbenzoic acid, 24
Fluorbenzol, 24
Fluorides, alkaline, 288
volumetric estimation of, 70
Flux for minerals, sodium as a, 224
Flying of birds, mechanism of, 120
Fontaine and De Clermont, MM., action of oxychloride of carbon on hydride of octyl, 48
Fontaine, Dr., preparation of bibromated ethylen, 21
Food, insufficient, counteracting effects of, 166
Forbes, D., F.R.S., report of committee on chemical nature of cast-iron, 161
utilisation of sewage, 148
France, higher public instruction in, 94
Frankland, E., F.R.S., "Lecture Notes for Chemical Students" (review), 10
Franklin Institute, 20
Freese, C., chromates, 35, 95
Freezing-points of saline solutions, 21
Frenzel, A., lithiophorite, 215
Fresenius, R., analysis of substances which, on being heated with hydrochloric acid, yield chlorine, 227
pure hydrochloric acid, 227
Freymond, H., pomatum, 118
Friedel, Dr., the Jecker prize, 46
and A. Ladenburg, silico-propionic acid, 22
Fricke, F. G., bromonitro-benzolsulpho acid, 215
Frölich, O., theory of Poisson relating to temperature of the globe, 227
Frot, M., ammonia machine, 47
Fuchs, C. W. C., edible earth, 217
Fuel, agglomeration of, 107, 119
"Fuel of the Sun" (review), 11
Furfurol, 84
Furnace gas, for chemical operations, at white heat, 211

Gabbro mass, 323
Gaize, 34
Gal, H., and A. Cahours, action of chlorides of platinum, palladium, and gold upon phosphines and arsines, 58
new derivatives from triethylphosphine, 22
compounds homologous with tartaric and malic acids, 107
bromated derivatives of anhydrous acetic acid, 70
Gallic acid, derivatives from, 288
Galloway, R., chemical problems, 310
Galvanic batteries, 69
electricity, liquid conductors of, 35
element constant with one liquid, 168
Delaurier's, 94
Galvanometer, M. Bourbouze, 94
Garnier, J., geological notes on Oceania, 108
Garrigou, F., and De Chasteigner, M.M., contemporaneousness of man, with the large Ursus spelœus, and the reindeer in caverns of Gargas (Haute Pyrénées), 70
chemical examination of piece of cement metamorphised while immersed in the water of Bayen de Luchon, 70
Gas engineers' (German) report on water supply to towns, 107
from petroleum, 203
furnace for chemical operations at a white heat, 211
meters, 168
metropolitan, 33, 201
molecules, size of, 130
rules and regulations concerning, for Karlsruhe, 203
Gas-burner, rotating, 59
Gas-water, separation of tarry matter from, 324
Gas-work furnaces, utilisation of waste heat, 59
Gas-works, ash and coke from, for brickmaking, 36
Gaseous products of combustion of coal, 22
Gases and vapours, indices of refraction and measurement of their dispersion, 35
compressibility and expansion of, 34
expansion of, 155
force by moving, 95
liquefiable, elastic force of, 167
motion of through pipes and tubes, 108, 119
sound in, 96
two specific heats of, estimation of the rapport, 94
Gautier, Dr., researches on albumen, 190
meteorological observations on the coast of Labrador by Moravian missionaries, 60
Gay-Lussac, J., compounds homologous with tartaric and malic acids, 107
Gehren, H. von, and R. Schmitt, fluorbenzoic acid and fluorbenzol, 24
Gelatinous precipitates, treatment of, 246
Gems and precious stones, 284
Geological notes, 108
studies concerning the Orient, 202
Gerad, C., climate of the Elsasz and the Vosges, 34
German chemists, labours of in the past year, 47
Germ theory of disease, 195
Germination, action of light on, 264
Gessert, J., anthracen, 83
Geuns, van J., and Baumhauer, von E. H., report on purification of the air of hospitals by means of combustion of organised germs, 72
Geuther, A., and O. Frœlich, volatile acids contained in croton oil, 323
Geyerfelt, H. von, action of hypochlorous acid upon chloride of allyl, 36
Gibbs, W., liquids of high dispersive power, 282
optics, 96
Gibsone, B. W., the late Dr. Miller, 189
Gieseke, A., oil of rue, 202
Gillieron, V., cretaceous formations in the exterior Alps, 108
Girard and Poulain, M.M., action of vapours of alkali metals upon molten cast-iron, 48
Givard, M., draining of the Dombes, 120
Glaciair striæ on Fontainebleau sandstone, 167
Glaciers, ancient, of the Auvergne, 108
Glaser, C., derivatives of cinnamic acid, 35
Glass, alabaster, analysis of, 275
manufacture of, 59
Glau, P., absorption of light, 240
Glaukopyrite, 90
Glinsky, G., cyanchlorhydrine of ethyl-glycerine; and on monochlorolactic acid, 299
Globe, temperature of, 227
Glue, 47, 179
Glutz, L., amido-sulpho-phenol, 215
Glyceric combinations, 155
Glycerine, 71, 154
metallic derivatives of, 178
solubility of glue in, 276
Glycol, aromatic, 21, 168, 202
Godwin, B., principle of repetition in chemical analysis, 190, 269
Gold, absorption of sulphur by, 282
chloride of, action of upon phosphines and arsines, 58
and compounds, researches on, 119
Goldschmid, J., aneroid barometer for heights, 274
Gongs, manufacture of, 107
Göppelsroder, F., estimation of nitric acid in potable water, 227
Görke, O., Japanese firework mixture, 203
Gorup-Besanez and F. Grimm, synthesis of the oil of rue, 59
Gossage, W., Lancashire alkali trade, 161
Gottgetreu, R., drying of wood, 263
Gould, B. A., physical constitution of the sun, 24
Græbe, C., acridine, 192
anthrachinon, alizarine, and purpurine, 130
some derivatives of naphthaline which belong to the chinons, 82
pyren, 192
and C. Liebermann, products of the distillation of coal-tar which have a high boiling-point, 213
Graff, M., corrosion of iron water-pipes, 23
Grahn, M., hydrotimetry, 287
Grape-sugar, estimation of, 36
to reduce tellurous oxide, 312
Grapes, preservation of fresh, 180
Graphite, testing of, 311
estimation of in carburetted iron, 35, 317
Grashof, Dr., permanent motion of gases through pipes and tubes, 108, 119
Gray, J. St. Clair, filtration of strong acids, 165
Gregson, T., brewing queries, 84
Gressler, E., artificial mineral waters, 179
Griess, P., azobenzol-sulphuric acid, 35
benzo-creatine, 154
diamido-benzoic acid, 83
diamido-nitrophenylic acid, a new derivative from picric acid, 35
Griffin, C., gas-furnace for chemical operations at a white heat, without the aid of blowing machine, 211
Grimaux, E., aromatic glycol, 21, 168, 202
Grimm, F., and Gorup-Besanez, synthesis of oil of rue, 59
Groshans, J. A., specific heat of solid and liquid bodies, 72
temperature of volatilisation, and specific heat of solid and liquid bodies, 71
Groth, P., relation between crystalline shape and chemical constitution of some organic compounds, 46, 60, 215, 240
Grothe, H., paper and its raw materials, 83
Grotto of Scé, 60
Gruber, A., and R. Otter, sulphotoluide, 35
Grüner, Dr., purification of oil of turpentine, 107
Guaiacum resin, test for, in jalap resin, 95
Gudkow, M., substance present in bran which yields furfurol, 84
Gueront, A., chlorides of sulphur, 226
Güldberg, Dr., law of freezing points of saline solutions, 21
Gumbellite, 239
Gumbel, Prof., riesvulkan and volcanic phenomena in the Rieskessel, 239
Gun-cotton, manufacture and sale of, 263
Gunpowder, manufacture, keeping, sale, and transport of, 263
prepared with chlorate of potassa, 143
Günther, Dr., quantity of tannic acid in catechu, ratanhia, kino, and other drugs, 216
Gustavson, G., haloid compounds of boron, 299
Guyot, J., acoustical attraction and repulsion, 71
utilisation of vine leaves and cuttings of young vine twigs, 94
vintage of wines, 36
volumetric estimation of soluble fluorides, 70
Gypsum, production of sulphuric acid from, 23

HABERMANN, J., sugar, 47, 167
Habets, A., agglomeration of fuel, 107, 119
Hagenbach, E., melting of lead shot fired against an iron target, 191
Hager, Dr., sulphate of soda in carbonate of soda, 83
Harcourt, A. V., F.R.S., determination of sulphur in coal-gas, 307
reaction between water and nitrogen-tetroxide, 286
Hare's blowpipe, calorific power of, 207, 217
Hargreaves, J., separation of phosphoric acid from iron ores and iron cinders, 170
Hart, P., condensation of the nitrous vapours in manufacture of sulphuric acid, 225
Hausmann, M., activity of the Siivern disinfectant, 107
Havrez, P., drying woollen fabrics, 120
Hay, G., nitric acid dissolves tin, 298
"Heat a Mode of Motion" (review), 116
mechanical equivalent of, 70
set free by mixing two liquids, 119
radiation, 191
specific of solid and liquid bodies, 71, 72
utilisation of gas-work furnaces, 59
Heated air, substitution for oxygen for thermal and illuminating effects, 103
Heilmann, R., condensation of nitrous vapours in the manufacture of sulphuric acid, 225
Heintz, W., action of ammonia on α chloro-propionic and on β iodo-propionic acid, 287
carbonic acid ether of the glycolic acid ether, 82
diglycolamide nitrate of silver, 287
estimation of phosphoric acid as ammonio-magnesium phosphate, 227
Hellmann, M., compasses for drawing very minute circles, 179
Helmersen, G. von., lignite, 154
Henbane, distribution of nitrogen in, 215
Henniger, A., chlorhydride of cyanogen, 191
Henry, A., desilverising lead, 108
L., glyceric combinations, 155
new and generally applicable method for the preparation of organic chloro-bromated compounds, 22
organic chlor-bromine compounds, 84
pentachloride and pentabromide of phosphorus upon divers ethers, 82
ether-derivatives of polyatomic alcohols and acids, 59, 154
tribromhydrine, 84
Herklots, J. A., two new series of Crustaceæ living as parasites on fishes, 71
Hermann, R., composition of columbite, 166
ferro-ilmenite, 166
lawrowite and vanadiolite, a new mineral, 60
hair hygrometer, 83
probable identity of laxmannite and vauquelinite, and on phosphorchromite, a new mineral, 60
samarskite, 166
separating the acids of niobium and ilmenium, 166
Herwig, Dr. H., behaviour of vapours as regards the law of Mariotte and Gay-Lussac, 240
Hesse, O., wax in opium, 130
white cinchona bark, 82
Heuzé, Dr., quinquina-chocolate, 48
Hexyl-hydride, 84
Heyneman, A., new derivatives from toluol, 144
Highton, H., artificial stone and silica, 195
magnetic power evolved by a battery, 285
magnetism and diamagnetism, 321
maximum magnetic power evolved by a galvanic battery, 205, 271
new electro-dynamic law, 238
Higgins, S. B., snake poison and its antidote, 179
Hirsch, M., levelling and survey in Switzerland, 167
Hlasiwetz, H., constitution of the combinations of the camphor group, 59
sugar, 47, 167
Hoffman, C. K., and H. Weyenbergh, place assigned to chiromys in natural classification of animals, 72
Hoffmeister, W., on phenyl-ether and diphenyl-oxide, 214
Hofmann, A. W., F.R.S., alternate reduction and oxidation, 130
aniline dyes, 130
aromatic cyanates, 130, 287
contribution to our knowledge on phenyl-xantho-grenamide, 214
fluid cyanogen, 130
German Chemical Society of Berlin, 143

Hofmann, A. W., F.R.S., ignition of hydrogen compounds in contact with fuming nitric acid, 130
isomers of cyanuric ethers, 34
liquefaction of cyanogen, 113
methyl-aldehyd, 83, 287
researches made in laboratory of Berlin University, 214
molecular volume of chinon, 83
nitriles, 263
separation of the ethyl bases from each other by means of oxalic ether, 214
Hofmann's violet, 192, 204
Hohn, H., preparation and constitution of hyoscyamine in relation to the other constituents of semina hyoscyami, 179
Holland, P., behaviour of rosaniline towards agents of substitution when attached to animal fibres, 291
Holtz's electrical machine, 72, 155
Homologues of isethionic acid, 153
Hope, W., antiseptic treatment of contagion as illustrative of the germ theory of disease, 195
Hoppe, R., vibrations of string of musical instrument, 96
Hops grown in the Elsasz, analysis of, 47
Horen, F. van, natural pits in senonian chalk formation of Brabant, 167
Horn, black dyeing of without the application of boiling heat, 154
Hospitals, purification of air, 72
Hot blast for blowpipe purposes, 103
Hovey, Rev. H C., the hailstorm of the 20th of June, 1870, 323
How, H., Stellarton acid-water analysis, 12
Huber, Dr. T., effect of wind and weather as affecting draught of chimneys, 323
Hübner, H., brom-benzol-sulphochloride, its derivatives, and the position hydrogen occupies in benzol, 144
bromonitro and bromamido benzol, and the position the hydrogen and benzol occupies, 84
bromo-sulpho-toluol, 226
chlorides of sulphur, 226
mono-bromotoluol and the derivation of isomeric amido bases from a hydrocarbon, 82
sulpho-acids and sulphohydrates derived from crystallised bromotoluol, 144
vertical oil gas retorts, 179
and F. C. G. Muller, formation of chloride of carbon, C_2Cl_6, from acetic acid, 70
glycerine compounds, and a new kind of formation of allylic alcohol, 71
and J. Upmann, thihydrobenzoic and dithiobenzoic acids, 23.
Huggins, W., spectra of erbia and some other earths, 175
Hurter, F., time needed for the completion of chemical change, 193
Husemann, T., alkaloids, 192
A., meteoric dust among snow, 262
mineral springs in the neighbourhood of Chur (Switzerland), 22
Huxley, Prof., inaugural address as President of the British Association at Liverpool, 133
Hydrate of chloral, chemical nature of, 46
Hydrates of platinic acid and platinate of barium, 47
Hydrocarbons, 299
action of chloride of chromic acid on, 96
Hydrochloric acid gas, 84, 96
pure, 227
Hydrofluoric acid in aqueous solutions, 83
Hydro-fluosilicic acid, 179
Hydrogen, action of upon oxide of iron, 34
apparatus, 216
chlorocyanide of, 59
compounds, ignition of, in contact with fuming nitric acid, 130
flame, 191
and iron, 155
phosphuretted, action of on zinc-ethyl, 299
position in benzol, 144
Hydrogenium, thermical researches on alloy of palladium with, 58
Hydrotimetry, 287
Hygrometer, hair, 83
Hyoscyamine, preparation and constitution of, 179
Hypochlorous acid and chloride of allyl, 36
Hyposulphites, sensitive test for, 167
Hyposulphite of soda for volumetric estimation of iron, 72
for preparation of organic sulphur compounds, 35

ICE, artificial, 119
melting to decrease drought, 36
Ilmenium and niobium acids, separation of, 166
Imbert, M., mixture to render textile fabrics impermeable to water and incombustible, 47
Incandescence of ammonio-phosphate of magnesia and pyrophosphate of magnesia, 23
Incrustatiop of boilers, 72
Indigo, 180, 192
Indigo-blue, reduction of isatine to, 59
Indium extraction from zinc-blende, 312
Induction currents, direction of obtained by electrical discharges, 22
sparks, 35
Induline, a new blue dye material, 225
Ink, black, indelible, 225
Inuline, modifications which it undergoes, 251
Iodic acid, properties of, 251
Iodides, organic, conversion of into bromides, 46
Iodine and bromine, production of, 178
colours exhibited by, 96
for detecting gold, 245
from substances containing it, 300
manufacture of from Chili saltpetre, 225
Iodphosphonium for reducing aromatic hydrocarbons, 201
Iridosmine, fusing, 225
Iron, 71
action of water upon, 34
and hydrogen, 155
and steel, crystallisation of, 94
determination of carbon in by the colorimetric process, 101
carbon in, 311
carburetted, graphite in, 35, 317
cast- and wrought-, and steel, for engines and machinery, 179
report of committee on chemical nature of, 161
"rochage" of, 69
special kinds of, 34
electro-deposition of copper and brass upon, 1
electro-magnetic behaviour of, 144
enamelling of, 274
estimation of, 72, 256
industry, M. Jordan on, 72
in Homer's period, 108
ores and iron cinders, separation of phosphoric acid from, 170
Iron, oxide, action of hydrogen on, 34
pig-, estimation of sulphur, phosphorus, and silicium present in, 144
refining for cast-steel, 108
pyrites and grey cobalt, 287
volumetric estimation of, possible source of error in Penny's process, 313
water-pipes, corrosion of, 23
Isatine, reduction of to indigo-blue, 59
Isethionic acid, 153, 312
Isobutyl-benzol and isobutyl-anisol, 214
Isocaprin series, derivatives of, 95
Iso-di-naphthyl, 296
Isoclase and kollophane, 166
Isomeric bodies, 173
cresols, 83
Isomerism in the benzol series, 167
of the elements, 47
Isomers of amyle, 230
of cyanuric ethers; 34
Isotaurine, 215
Itacolumnite, 111, 265
Iva (*Achillea moschata*), 178
Iwanof-Gajewsky, 84
Ivory, bleaching, 48

JACOBI, R., manufacture of mineral oils, paraffin, and the distillation of brown coal in Saxony, 191
Jaffé, B., rufigallic acid, 153
Jannasch, P., products of the oxidation of durol, 226
Jamin, M. J., reply to papers published by H. Sainte-Claire Deville, 94, 106
variations of temperature produced by mixing two different liquids, 21
Japanese firework mixture, 203
Jecker prize, 46
Jekyll, W. R., action of sulphuric acid on diallyl, 221
Jena, Dr. A., benzilic acid, 167
benzoine and dibenzoyl, 167
Johannsen, E., behaviour of platinum-chloride towards lime and baryta-water, 178
Jordan, S., cast-steel from refined pig-iron by intermolecular combustion, 108
iron industry, 72
manufacture of special kinds of cast-iron, 34
Jouglet, Dr., cotton respirators, 82
Jousset, Dr., essay on venom of scorpions, 143
Judson, W. E., contribution to the history of trichloro-acetic acid and trichloro-crotonic acid, 214
Juice of an euphorbiaceous plant, 215

KACHLER, J., curcumine, 154
Kæppelin, D., madder applied to dyeing and printing, 107
Karrass, T., laws of formation of Kundt's dust figure, 35
Kekulé, A., crotonic acids, 84
and Th. Zincke, polymeric modifications of aldehyde, 47
Kellner, O., Philipp's carboxygen illumination, 107
Kelp, 312
manufacture of, 324
Kempf, Th., action of fluid phosgen on some organic compounds, 24
Kepler monument, inauguration of, 60
Kernan, E., sub-permanent magnetism, 261
Kestner, A. S., composition of crude soda; and on the loss of sodium resulting from its manufacture according to Le Blanc's process, 21
Ketteler, E., dispersion of light 95
Kiln annular, 72
Kind, M., isotaurine, 216
King's College, 299
Kino, determining the quantity of tannic acid in, 215
Klein, Dr., iron and hydrogen, 155
Klimenko, E., action of chloride of phosphorus upon pyruvic acid, 47
Knapp, K., new method of estimation of grape-sugar, 36
theory of flame, 24
Knopp, W., albumen compounds, 84
Knosp, R., induline, a new blue dye material, 225
Kobell, Dr. von, gumbellite, 239
water of crystallisation, 215, 239
rabdionite, a new mineral; and on asbolan, 24, 239
Kokscharon, N. von, chondrodite crystals; and crystals of greenockite, 154
Kolbe, H., chemistry in France, 191
phosphorus-platinum compounds, 215
Kollophane and isoclase, 166
König, J., occurrence and elementary composition of vegetable wax, 59
Kopp, E., treating native sulphurets, antimoniurets, arseniurets of copper, lead, nickel, silver, and iron, 83
Koninck, L. L. de, phloretic acid and sulpho-hydrocinnamic acid, 262
Krämer, G., products of action of chlorine upon aldehyd, 214
Kraut, K., saliretine, 288
Krawsowsky, M., reactions exhibited by mercurallyl, 300
Kreja, Dr., uratonil, 214
Krieg, O., preparation of woody substances into pulp for making paper, 83
Kuchenmeister, O., nitro-naphtoë, 213
Kuhlberg, A., and F. Beilstein, isomerism of the benzol series, ortho-nitrotoluol, 23, 202
chlorinated para-chlorobenzoic acid, 202
isomerism in the benzol series, 167
Kundt, A., absorption-spectrum of fluid hyponitric acid, 240
simultaneous boiling of two liquids which are not miscible, 191
standing vibrations and sound figures in elastic and fluid liquids by aid of solid-sounding plates, 96
Kundt's dust figure, 35
Kurz, A., minimum of prismatic aberration, 227
observations on force of moving gases, 240

LABORATORY accident, 36
at Aix-la-Chapelle, 58
Guide," Church's (review), 201
instruction, 123
operations, maintaining constant temperatures in, 225
Laborde, M., experiments on the armatures and fixed plate of Holtz's electrical machine, 94
Lachmann, A., manufacture of iodine from Chili saltpetre, 225
prevention of the spontaneous combustion of coals, 225
Lacquer work composition of Chinese, 119
Lactic acid, 264
Ladenburg, A., and C. Friedel, silico-propionic acid, 22
on stanno-triethyl, 130
Ladies' Medical College, 165
Lagermarch, B., action of bromine upon pyro-tartaric acid, 23

Lamfrey and Brosse, M.M. effervescing cyder, 34
Lamy, M., M. Jordan's work on the Iron Industry, 72
Landes, Dr., woody fibre a substitute for paper-making materials, and on Völter's wood-shaving and pulping machine, 23
Lane, J. H., solar temperature, 96
Lang, J., velocity of light while passing through quartz, 191
Lasaul, Dr. A. von., changes produced in brown coal by coming in contact with basalt, 240
Laschinoff, D., alteration of Bunsen's battery, 274
Latour, M., bromhydrates of quinine and cinchonine, basic and neutral, 119
Laurel herb, chemical researches on, 179, 228
Laxmannite and vauquelinite, identity of, 60
Lead, alloy of with manganese, 194
desilverising, 108, 240, 311
improved method of producing white pigments from, 45
oxide of from Algeria, 58
roofing, 12, 24
shot, melting of, fired against an iron target, 191
thin sheet instead of lint, 70
tubing, tin-lined, 168
Le Blanc's process, loss of sodium in, 21
"Lecture Notes for Chemical Students" (review), 10
Lectures at London medical schools, 125
Leeds, Prof., analysis of some hitherto undetermined American minerals, 173
chemical tables, 39, 163, 306
scientific notes from America, 294
Lefranc, M., modifications which inuline undergoes, 251
Legrand, M., Deluc's thermometer, 34
Leison, W. G., precipitation and determination of metals of the magnesium group in form of oxalates, 190, 210
Length measures, exact and precise comparison of, 71
origin of the prototype of the measures of, 59
Lenses, photographic properties of images produced by, 191
Lepidoptera, 72
Le Roux, M., annual Tremont prize, 46
Letheby, Dr., gas supplied to London, 201
quality of the gas supplied to the Metropolis, 33
Lette's Diaries for 1871, 311
Leucite, mineral, remarks on the alkalies contained in, 13
Levelling and survey in Switzerland, 167
Levison, W. P., improvement in galvanic batteries, 69
Lewald, P., tin which has been exposed to a great degree of cold at St. Petersburg, 22
Lex, R., new reactions of phenol, 46
Lichens, spirit from, 23
Lieben, A., normal amylic alcohol, 106
Liebermann, C., anthrachinon, alizarine, and purpurine, 130
and C. Graebe, products of distillation of coal-tar which have a high boiling point, 213
Liebig, health of, 168
Light, absorption of by transparent media, 35
action of on germination, 264
upon tissues of some mono- and di-cotyledonous plants, 154
amount transmitted by crown glass, 96
new artificial, 20
dispersion of, 95
velocity of passing through quartz, 191
Lightning conductors, 33
curious effects of, 155, 227
Lignite, 154
Lime, carbonate of, 150
and carbonic acid, apparatus for continuous preparation of, by one operation, 94
and cement, 22
mortar, 226
phosphate of, 178, 228
Lime-lights, 208
Limpricht, H., benzoine, 167
derivatives of muconic acid, 130
toluylen-oxide, 167
Linard, M., conveying beet-root juice, 72
Linde, C., production of cold by mechanical means, 203
Linen fabrics, report on apparatus for cleansing, 34
Linnemann, E., conversion of butyl-iodide of fermentation into the amin-basis of trimethyl-carbinol; and butylamine into trimethyl-carbinol, 83
Linseed oil, solubility of sulphur in, 214
Lint, thin sheet-lead instead of, 70
Liquids, inflammable, 36, 60
magnetic rotatory polarisation of, 58, 108
of high dispersive power, 282
simultaneous boiling of, which are not miscible, 191
superficial tension of, 35
Lithiophorite, 215
Liversidge, A., nuclei and supersaturated saline solutions, 90, 97, 109, 242, 253, 298
Lead and platinum, alloy of, 263
Loeff, P., history of continuous annular shaped brick-kilns, 144
Loew, O., formation of ozone by rapid combustion, 13
hydrogenium-amalgam, 96
number of isomeric bodies, 173
Lodran, meteorite, 96
Lommel, Prof., luminosity of water hammer, 239
London Institution, 33, 93, 284, 305
Lorenz, L., molecular theory and doctrine of electricity, 227
Lösch, A. and F., fermentable matter in the river Newa, 203
Lubaoin, N., cinchonin-chlorine, 202
Lucas, M., duration of electric spark, 21
F., possibility of obtaining luminous signals visible at great distances, 58
Ludwig, E., analysis of silicates, 240
derivation of naphthaline which belong to the chinons, 82
Luminous phenomenon, 120
signals visible at great distances, 95
Lüneburgite, 239
Lunge, G., purification of syrups, 273
Luvini, G., "Saggio di un Corso di Fisica Elementare Proposto alle Scuole Italiane" (review), 115
Lwow, M., hydrocarbons, 299
Lyons, A. B., sulphocarbolate of zinc, 276

MACLAY, N. M. von, sponges of the White Sea and Arctic Ocean, 154
Madder applied to dyeing and printing, 107, 180, 191, 233
Magic-lantern pictures on gelatine, by a new method, 20
Magnesia, incandescence of, ammonio-phosphate of, and pyro-phosphate of, 23
and alumina, circumstances which favour the simultaneous precipitation of, by ammonia, 4
Magnesite, abnormal behaviour of, 274
Magnesium group of metals, precipitation and determination of in form of oxalates, 190, 210
pulverised, as powerful reducing agent, 167
Magnetic needle, 70, 119
perturbations observed by De Saussure, 22
power, maximum of, evolved by a galvanic battery, 205, 285, 310
rotatory power of liquids, 58
Magnetism and diamagnetism, 321
influence of on electric jets propagated in partially-vacuous space, 22
Magnus, Prof., change which heat radiation undergoes by roughness of surface of bodies, 191
successor to, 47
Maikopar, B., four isomeric ethyl-naphthol-sulpho acids, 84
Maish, J. M., solubility of glue in glycerine, 276
Malic acid, compounds homologous with, 107
Mammalia remains, 154
Man contemporaneous with the large Ursus spelæus and reindeer, 70
origin of, 120
of the Tertiary period, 119
Manganese, alloys of copper, tin, zinc, and lead with, 194
and cobalt, alloy, 34
estimation of, 186, 227, 236
salts of, experiments made with, 251
"Manufacture of Beet-Root Sugar in England and Ireland" (review), 19
"Manual of Colours and Dye Wares: their Properties, Applications, Valuation, and Sophistications" (review), 43
Manure, artificial, manufacture of from native phosphates, 47
Marbles from Tyree, 171
Marcon, J., glaciers of the Auvergne, 108
Marey, M., flying of birds, 120, 130
Markownikow, W., oxyisocaprylic acid, oxyisovalerianic acid, and dipseudopropyl-keton, 299
Mariotte's theory of barometrical oscillations, 143
Marquart, P. C., polybromides of tetra-ammonium bases, 24, 60
Martin, L. J., manufacture of sal-ammoniac and peroxide of manganese, 118
Martius, C. A., and P., Mendelssohn-Bartholdy, chloral, 46
Massie, Dr., testing fatty oils, 95
Materials, detonating, manufacture and sale of, 263
Matthiessen, A., committee on chemical nature of cast-iron, 161
obituary, 139
Maumené, M., melassimetry, 251
Mayer, A. M., electro-magnetism, 190
measuring electrical conductivities by means of two equal and opposed magneto-electric currents or waves, 323
J. R., the Poncelet prize, 46
McLeod, H., isomers of amyle, 230
Meat extract, 36, 48
Medals, 46
Medal-Lavoisiér, 119
Meister, O., adulterated starch, 214
cotton dressing, 214
Melassimetry, 251
Melsens, M., elastic force of liquefiable gases, 167
vitality of beer yeast and vaccine lymph, 167
Mendelssohn-Bartholdy and C. A. Martius, chloral, 46
Mène, C., analysis of hops grown in the Elsasz, 47
Mène, C., manufacture of artificial manure from native phosphates, 47
watering the streets with saline solutions instead of with water only, 47
wood for paper making, 192
Mensbrugge, C. van der, superficial viscosity of thin sheets of saponine solution, 22
Mercurallyl, reactions of, 300
Mercuro-dinaphthyl, 35
Mercuro-ditolyl, 35
Mercuro-monomethyl and mercuro-monoethyl acetic acid, 35
Mercury, extinction and reducing power of, 217
passage through glass capillary tubes, 191
fulminate, decomposition of, 168
Merz, V., preparation of napthoe acid, 144, 154
Mesitylen, 71
Messel, Dr., strychnine oxethyl compounds, 226
sulpho-maleinic acid, 226
Meta-naphthaline, 168
Metal, analysis of old yellow, 120
Metals, electromotive force by contact of, 191
peroxides of obtained by electrolysis, 240
of the magnesium group, precipitation and determination of in the form of oxalates, 190, 210
Metals and ores, oven for the smelting of, 47
Meteoric dust among snow, 262
Meteorites, 59, 95, 287
Meteorite of Lodran, 72
Meteorological observations on the coast of Labrador, 60
Meteorology of the spring of current year, 34
Methyl-aldehyd, 83, 287
Methyl-ethyl-carbinol, 70
Metrical system, international committee on, 117
Metz, A., beer from rice, 311
Meunier, S. A., burning mountain, 36
coal formation of the Lofoden Islands (Norway), 72
purification of dirty water, 95
from whence do meteorites come? 47
new use for hyposulphate of soda, 95
V., fatigue to eyes by artificial light, 95
test for ammonia in coal-gas, 120
utilisation of the waste heat of gas-work furnaces, 59
Meyer, V., chemical nature of hydrate of chloral, 46
dibrom-benzol, 214
Michaelis, A., action of ammonia upon chloride of thionyl and chloride of selenium, 226
Microscope, specimens of soundings for, 99
mechanical finger for, 55
Midy, J., estimation of glucose in sugars, 120
Military camps, uniformity of time for, 94
Milk adulteration, 61
analysis, 191
condensed, preparation of, 275
unequal production and difference of composition of from the same woman, 34
Millboard from peat, 108
Miller, the late Dr., 177, 189
Milliss, E., contribution to our knowledge of zirconium, 23
Millstone-grit, researches on, 167
Milner E. and J. G. Dale, an improved method of producing white pigments from lead, 45
Mineral springs at Chur, 22
analysis of water of, 144, 249
resources of the Ariège, 108
waters artificial, 179
oils, paraffin, and the distillation of brown coals in Saxony, 191

Mineral, American, analysis of, 173
from New Jersey, 96
Mineralogical chemistry, 219
contributions, 96
"Mints, European, Report of Deputy Master of the Mint on" (review), 318
Miquel, F. A., contributions to our knowledge of the Flora of Japan, 71
Cycadæ, 71
Mixer, centrifugal, 60
Moens, J. B. C., researches on calisaya bark from Java, 23
Mohr, F., basicity, 59
analysing mineral waters, 249
estimation of manganese, 236
Moigno, Rev. F., curious circuit of lightning, 155
explosion of picric acid induced by ozone, 60
military camps, uniformity of time for, 94
Molecular action, founded on theory of capillary action, 155
motion, velocity of, 96
Mono-bromotoluol, 82
Monochloro-lactic acid, 299
Monochlorhydrine, action of silver upon, 191
Montagna, C., existence of organic remains in rocks supposed to be of igneous origin, 22
Montyon prize, 46
Moon, diffraction by, 24
Moreau, J., Lauden sandstone, 119
Morin, General, international committee on metrical system, 117
Morocco, geological description of, 167
Morphia, 262
Morphology of the shoulder muscles of birds, 71
Morren, Dr., Holtz's electrical machine, 155
Morris, Prof., gems and precious stones, 284
Mortar and lime, 226
Morton, H., erecting prism, 20
Moss and lichens, spirit from, 144
Most, M., reply to, 227
Mouldiness, prevention of in aqueous solutions of tartaric acid, 13
Mountain burning, 36
Mourlon, M., geological description of Morocco, 167
Mouth of Seine, lithological map of M. Delesse, 94
Muconic acid, 190
Mülhäuser, H., preparation of naphthoe acid, 144, 154
Mulder, E., sound in gases, 96
velocity of molecular motion, 96
Müller, A., methods of water analysis, 153, 214
F. C. G., bromo-sulpho-toluol, 226
and H. Hubner, formation of chloride of carbon, C_2Cl_6, from acetic acid, 70
glycerine compounds, and new kind of formation of allylic alcohol, 71
H., composition of carmine, 57
Dr. J. J., elastic vibrations, 96
J. W., liquid conductors of electric currents, 35, 191
W., luminosity of phosphorus, 240
Muntz, A., composition of skin, the modifications it undergoes by tanning and fermentation of tannin in tan pits, 155
Mussy, M., mineral resources of the Ariège, 108

NADORITE, a new mineral, 82
chemical composition of, 143
Naphtha and ozokerite, 203
Naphthoe acid, preparation of, 144, 154
Naphthalin-carboxylic acid, synthesis of, 36
Naphthaline, 82
homologues of, 167
Naphthol nitration, 312
Naphthylamine, 130
Narcotics used by inhabitants of Central Asia, 215
Nasse, O., and C. Engler, ozone and antozone, 35
Natural pits of the coal measures, 119
Naumann, A., and E. Vogt, non-existence of the chlorocyanide of hydrogen, 59, 178
vapour density of acetic acid, 154, 202
Nettleton, W., aluminium in batteries, 228
Neujean, A., testing carbonate of lead for manufacture of crystal glass, 251
Neyreneuf, M., electric condensation, 22
Nichols, W. R., composition of the acid-oxalates of potassium, ammonium, and sodium, 14
solubility of the oxalate of potassium, sodium, and ammonium in water, 244
Nickel, galvanical deposition of, 22
protoxide of chromate of, 287
hydrate of, 287
soda-nitrate used in the metallurgy of, 83
Nile, first cataract, 72
water, 202
Niobium and ilmenium acids, separating, 166
Nitric acid, action of on toluidine, 155
dissolves tin, 298
estimation of in potable water, 227
facts relating to chemical history of, 48
formation of during combustion of hydrogen in air, 130
solubility of tin in, 322
Nitriles, 263
Nitrobenzyl-cyanide and amidided benzyl-cyanide, 47
Nitro-chlorphenol, 312
Nitro-derivatives of phenyl-acetic acid, 130
Nitro-naphtoë acid, 213
Nitro-substitution compounds of the orcins, 98
Nitrogen from organic nitrogenous substances, 82
in black and white henbane, 215
organic, retention of by charcoal, 183
Nitrogenous substances in beer, 179
Nitrous vapours, condensation of, 225, 264
Nöllner, C., lüneburgite, 239
Nomenclature, chemical, 48
Nordenskjold, Dr., platinum in Lapland, 96
Notes, scientific, from America, 294
Nuclear action of a saline crystal on a supersaturated solution of the same salt, 277
Nuclei and supersaturated saline solution, 90, 97, 109

OBSERVATORY, new astronomico-meteorological, 48
Oil, castor, behaviour of with petroleum and paraffin oils, 162
croton, volatile acids contained in, 323
of rue, 202
of turpentine, purification of, 107
painted surfaces, cleaning, 251
Oil-gas retorts, vertical, 179
Oils, fatty, testing of, 95
for machinery, 191
Oliveira, M. L., phenomenon of Choc en Retour, 118
Opium, from papaver plants, 192
testing value of, 227
wax in, 130
Oppenheim, A., action of sulphuric acid on organic chlorides which contain nitrogen, 213
Oppenheim, A., conversion of organic iodides into bromides, 46
and Ador, E., sulphobenzoic acid, 213
Oppermann, M., paper and millboard from peat, 108
Optical change of phase, compensation of, 227
Optics, notices of, 96
Orange-lead, 300, 312
Orchil paste, latest novelty in, 12
Orcins, nitro-substitution compounds of, 98
Organic acids, synthesis of, 168
bases for colouring matters, 180
chlorides which contain nitrogen, action of sulphuric acid on, 213
compounds, relation between crystalline form and chemical constitution of, 60
iodides, conversion of into bromides, 46
remains in rocks, 22
substances, decomposition of prevented, 281
Ortho-nitrotoluol, 23, 202
Osmose, 24
Osseine in fossil bones, 107
Otto, R., acetic acid mercuro-monomethyl and acetic acid mercuro-monoethyl, 35
mercuro-dinaphthyl, 35
preparation of organic sulphur compounds by means of hyposulphite of sodium, 35
two isomeric pentachlorbenzols and bichlorbenzol-chloride, 35
and E. Dreher, behaviour of dibenzyl at a high temperature, 35
conversion of thiophenol, 35
on mercuro-ditolyl, 35
and A. Gruber, sulpho-toluide, 35
udemans, A. C., estimation of iron as a peroxide salt, 256
volumetric estimation of iron by means of hyposulphite of soda, 72
Oxalate of potassium, sodium, and ammonium in water, 244
Oxalic acid decomposition, 58, 168, 251
ether, separation of ethyl bases by, 214
Oxamyl-sulphon acids, 312
Oxychloride of carbon, action of upon the aromatic hydrocarbons, 48
action of on hydride of octyl, 48
Oxyhydrogen light at Beauvais, experiments made with, 48
Oxygen, solubility of in molten silver, 191
Oxyisocaprylic acid, 299
Ozokerite, 203
Ozone, 24
and antozone, 35
explosion of picric acid by, 60
from active combustion, 13, 24, 57

PAINTING by means of injection, 59
Palladium alloy, metallic character of with hydrogenium, 58
chloride of, action of upon phosphines and arsines, 58
Palm, Dr., analysis of a crude potash, 215
milky juice of an euphorbiaceous plant, 215
narcotics used in Central Asia, 215
pharmacognostic substances met with in Central Asia, 203
Papaver plants, opium from, 192
Paper, manufacture and quality of, 23, 83
from peat, 108
making from wood, 192
Papillon, F., composition of bones, 106
Paraffin, 191
purification of, 274
Paralytics, chemical composition of the bones of, 206
Parasites on fishes, 72
Paris exposition, 1867
Paris, F. E., useful application of electric light, 119
Parker, J. S., estimation of manganese in spiegeleisen, 186
Possible source of error in Penny's process for volumetric estimation of iron, 313
Parthenogenesis with Lepidoptera, 72
Payen, M. A., new system of conveying beet-root juice, according to M. Linard's proposal, 72
Peat-ash, analysis of, 275
Peat as fuel, 312
for paper and millboard, 108
and peat bogs, 168
Peckolt, P., agoniada and agonidine, 84
Pelouze, Theophile Jules, biography of, 46
Pentabromide of phosphorus, action of upon azoxybenzide, 144
Pentachlorbenzols, two isomeric, 35
Pentachloride of phosphorus, action of upon hyposulphite of lead, 47
Perkin, W. H., on the aniline or coal-tar colours, 17, 29, 40, 53, 64, 79, 92, 100
derivatives of anthracene, 37, 283
new derivatives of coumarin, 85, 308
Periphyllus testudo, 72
Perret, A., apparatus for continuous preparation of carbonic acid and lime by one operation, 94
Personne, J., conversion of chloral in aldhyd by inverse substitution, 58
Persulphide of hydrogen, 12
Petersen, T., nitro-chlorphenol, 312
Petit, A., properties of albumen of eggs, 168
Soluble iodide of starch and decolouration by heat, 119
Petrified forest of Cairo, 72
Petroleum, gas from, 203
Peyrat, M. du, dry season of 1870, 168
Pfaff, F., water evaporated by an oak tree, 239
Pfankuch, F., on diphenyl, 60
Pfaundler, L., caloric capacity of water, 227
molecular heat of hydrates of sulphuric acid, and heat of combination evolved by their admixture with water, 214
Pfister, M., hair hygrometer, 83
Pharmacognostic substances from Central Asia, 203
Phenic acid, hygienic use of, 82
Phenol, products of conversion, 288
some new reactions of, 46
Phenophthalmotrope, 71
Phenyl ether, 214
Phenyl-sulphydrate into phenyl-bisulphide, 35
Phenyl-xantho-genamide, 214
Phillips's carboxygen illumination, 307
Phillips, J. A., Claudet's process for extraction of silver, 184
Phillips, S. E., platinum ammonia compounds, 49
Phipson, T. L., aluminium weights, 187
Phloretic acid, 262
Phloridzine, 287
Phosgen, action of upon some amides, 144
on zinc methyl, 209
Phosgen fluid, action on some organic compounds, 24
gas, action of upon the aromatic hydrocarbons, 48

Phosphate of lime, 228, 239, 240
process for sewage utilisation, 148
Phosphates and arseniates, 61
new, 166
Phosphines and arsines, action of chlorides of platinum, palladium, and gold upon, 58
Phospho-platinic compounds, 19, 22, 34
Phosphorchromite, 60
Phosphoric acid, estimation of as ammonio-magnesium phosphate, 227
in phosphorites, 227
separation from iron ores and iron cinders, 170
Phosphor salt beads, crystals in, 60
Phosphorites, phosphoric acid in, 227
Phosphorus, amount of arsenic in, 276
luminosity of, 240
pentachloride and pentabromide of, action of upon ethers, 82
precaution in use of, 286
sulphur and silicium, estimation of in pig-iron, 144
vapour-density of, 106
Phosphorus-platinum compounds, chemical constitution of, 215
Photographic exhibition, 225
Photographical studies of the sun, 58
Photometric experiments, 96
Photometry, 107
Phthalic acid, 108
Phthalyl, 59
Pickering, E. C., diffraction produced by edges of the moon, 24
Picric acid, diamido-nitro-phenylic acid from, 35
explosion, 60
Pigments, amorphous silica for fixing, 83
anthracen, 59
Pilou, M., animal charcoal, 118
Pimont, M., prix des arts insalubres, 46
Pinard and Champeaux, M.M., furnace for distillation of bituminous shales, 47
Pindray's smoke-consuming furnace, 108
Pine forests, cause of fires in, 119
Piperonylic acid, conversion into proto-catechutic acid, 202
Pisani, F., nadorite, a new mineral, 82
Planta-Reichenau, A. von, analysis of water of thermal spring of Ragaz-Pfäfers, 178
the Iva, 178
Plantamour, M., levelling and survey in Switzerland, 167
Plants, mono- and di-cotyledonous, action of light on, 154
Plastic material, 120
Plateau's equilibrium figures, 227
Plateau, J., researches on equilibrium figures exhibited by a fluid mass without gravity, 240
Platin-ammonia compounds, 49
Platinic acid and platinate of barium, hydrates of, 47
Platinum and lead, alloy of, 263
chloride of, action of upon phosphines and arsines, 58
behaviour towards lime and baryta water, 178
compounds, 107
crucibles, loss of weight by continual ignition, 275
fusibility of in blowpipe flame, 268
in Lapland, 96
Platter, H., caloric capacity of water, 227
Plumb-line deviation, 154
Poelman, Dr., vital power, 47
Potash, chlorate of, crystallisation by fusion, 275
Poggendorff, J. C., electro-machine, diametrical conductors of, 95
Pohl, J. J., solubility of sulphur in an aqueous solution of carbonate of soda and in linseed oil, 214
Poison in bread, 215
Poisson's theory of temperature of globe, 227
Polarisation, circular, influence of temperature on, 215, 312
Poly-atomic alcohols and acids, ether derivatives of, 59, 154
Polybromides of tetra-ammonia bases, 24, 60
Pomatum for softening and whitening the skin, 118
Poncelet prize, 46
Popp, O., chromate of chromic oxide, 288
composition of sugar-cane, 70
Egyptian trona, 202
excrement of Egyptian bats, 202
incandescence, phenomena of ammonio-phosphate of magnesia and pyro-phosphate of magnesia, 23
presence of urea in bile, 288
qualitative detection of sulphurous acid and volumetric estimation of iron, 71
water of the Nile, 202
Porcelain ornamentation, 155
Post, J., sulpho-acids and hydrates derived from crystallised bromotoluol, 144
Potable waters, estimation of nitrates in, 94
Potash, chromate of, manufacture of, 274
crude, analysis of, 215
salts from sea-water, 112
permanganate of against coryza, 262
permanganate of with sulphuric acid, 24
Potassio-cobaltic nitrite, known as Fischer's salt, and analogous compounds, 8, 15, 26
Potassium, ammonium, and sodium, composition of acid-oxalates of, 14
silico-fluoride of, behaviour of in blowpipe flame, 275
Potatoes, historical facts about, 95
Poulain and Girard, M.M., action of vapours of alkali metals upon molten cast-iron, 48
Prat, J. P., gold and compounds, 119
Pribram, R., analysing milk, 191
Precipitates, gelatinous, treatment of, 190
washing and exhaustion of, 154
Prescott, A. B., apparatus for rapid evaporisation at limited heat, under reduced pressure, without a pump, 71
Prism erecting, 20
Priwoznik, E., bromogallic acid, 130
Prix des arts insalubres, 46
Problems, chemical, 310
Proctor, W., pulverisation of camphor, 275
roasting of coffee, 179
Propylen, haloid compounds of with hydriodic acid, 299
Propylic alcohol, normal derivatives obtained from, 325
Prototype metre, conference on the, 120
Prow, J., decreasing drought by accelerating the melting and floating down of ice in the polar seas, 36
Pumps, substitution of syphons for, 60
Purpurine, 130
Puscher, C., process for copying printed matter, plates, drawings, &c., 191
Pyramids of Villejuif and Juvisy, 34
Pyren, 192
Pyridine and chinolin, 201
Pyroxmalith, analysis, 288
Pyro-tartaric acid, action of bromine upon, 23
Pyrotechny, 288, 300
Pyruvic acid, action of chloride of phosphorous upon, 47

QUADRANT, decimal division of, 94
Quantitative analysis, 89, 99, 109, 163, 187
Quartz, velocity of light while passing through, 191
Quekett microscopical club, 69
Quetelet, A., declination and inclination of magnetic needle at Brussels in 1870, 119
Quinine, adulteration with salicine, 144
in barks, quantitative estimation of, 95
sulphocarbolate of, crystallisation of, 276

RABDIONITE, 24
and an asbolan containing lithia, 239
Rabuteau, M., counteracting effects of insufficient food 166
quantitative estimation of ammoniacal salts; causes for these salts existing in the human organism in infinitesimally small quantity, 21
Rademaker, C. J., amount of arsenic in phosphorus, 276
crystallisation of sulphocarbonate of quinine, 276
Radziszewski, B., nitro-derivatives of phenyl-acetic acid, 130
Rainfall on the French Alps, 82
Rain-water composition, 108
Rammelsberg, C., augite in meteorites, 96
composition of wootz, or Indian steel, 46
meteorites, 59, 95, 287
dimorphism of tin, 154
place thallium should occupy in series of elementary bodies, 60
relation of chemistry to mineralogy, 263
yttrocerite, 312
Ratanhia, determining quantity of tannic acid in, 216
Rathke, B., sulphocarbonylchloride and a new chlorosulphide of carbon, 312
Raulin, M., man of the tertiary period, 119
Rayet, G., reversal of the two sodium lines in spectrum of light produced by one of the protuberances of the sun, 21
Raulin, V., rainfall on the French Alps, 82
Rauwenhoff, N. W. P., character and formation of suber and liber in dicotyledonous plants, 71
Reboul, E., monobromated iodhydrates and chlorhydrates of ethylen and propylen, 251
Refraction of gases and vapours, 35
Refrigerator, Toselli's, 119
Regelation, apparent parallels to, 313
Reiche, Dr., cast-iron, wrought-iron, and steel for engines and machinery, 179
Reimann, M., amorphous silica for fixing pigments and dyes, 83
phosphate of lime as a mordant, 239
Reinsch, H., production of sulphuric acid from gypsum, 23
Reithinger, E., and M. Kuhn, spectra of negative electrodes and tubes, 240
Rembold, O., derivatives obtainable from gallic acid, 288
Remsen, J., homologues of naphthaline, 167
piperonylic acid, conversion into proto-catechutic acid, 202
Report of the Committee on the Chemical Nature of Cast-Iron, 161
Deputy Master of the Mint on European Mints (review), 318
"Researches on Diamagnetism and Magne-Crystallic Action, including the question of diamagnetic polarity" (review), 152
Resin in Tampico jalap, 288
Respirators, 82
Reynolds, O., tails of comets, the solar corona, and the aurora as electric phenomena, 294
Rice beer, 179, 311
Ricinine, 203, 229
Rich, J. T., coal and smoke consumption, 24
Riche, A., manufacture of tam-tams or gongs and cymbals, 107
Richtenhofen, Baron von, geological explorations in China, 323
Richters, Dr., Dr. Bischof's paper on fire resisting properties of clays, 155
T., changes coal undergoes by exposure to air, 22
E., estimation of sulphur, phosphorus, and silicium in pig-iron, 144
Rickards, R. H., Bunsen's filter pump, 77
Rien, A., madder extract for dyeing and printing, 180
Riedinger, L. A., gas from petroleum, 203
Riess, P., description of electrophoric machine suitable to charge batteries, 35
J., isobutyl-benzol and isobutyl-anisol, 214
Rieth, R., size of gas molecules o inorganic compounds, 130
Rinne, A., allyl-cyanide, 144
Ritsema, H. C., origin and development of the Periphyllus testudo, 72
Rochleder, F., colouring matters of madder, 233
Rock-salt for glass making, 179
Rocks in the Western Alps, 34
Rodenbach, Dr., universal origin of the prototype of the measures of length, 59
Roessler, W. T., minerals, 96
Rood, O. N., light, 96
Rosaniline, 130
behaviour of towards agents of substitution when attached to animal fibres, 291
Roscoe, H. E., address to the Chemical section of British Association, 139
spectroscope applied to Bessemer process, 44
Rose, G., relation between the hemiedric crystalline shape and the thermo-electric properties of iron pyrites and grey cobalt, 287
H., mesitylen-sulpho acids of mesitylen, 71
Rossetti, Dr. F., density and freezing point of mixtures of alcohol and water, 96
Rossi, A., normal amylic alcohol, 106
Rotatory power, apparatus for measuring, 168
Rothe, O., tannic acid, preparation of, 251
Rothenbach, M., Berne waterworks, 203
Roussille, Dr., luminous phenomenon, 120
Roussin, A., soluble vegetable tar, 118
Royal Irish Academy, 261
Rhenish-Westphalian Polytechnic School at Aix-la-Chapelle, 23
School of Mines, 20
Institution of Great Britian, 262
Rubidium and cæsium, 25, 44
salts, precipitation of with insoluble salts of lime, 150

Rüdorff, F., fusion and solidification point of fats, 191
photometry, 107
Rue, oil of, 59, 202
Rufigallic acid, 153
Rumpf, G., method of estimating manganese, 227
Rust, M., plastic material, 120

SACCHARINE juices, decolouration and defecation of by means of phosphates and alumina, 47
Sadtler, S. P., potassio-cobaltic nitrite, known as Fischer's salt, and analogous compounds, 8, 15, 26
Sagebien, M., system of water-wheels, 34
Sal-ammoniac and peroxide of manganese, combined manufacture of, 118
Salet, G., spectroscopic reactions of sulphur, and on flame of hydrogen, 191
Salicine, detection of in quinine, 144
Saline crystal, nuclear action of on a supersaturated solution of same salt, 280
solutions, freezing-points of, 21
supersaturated, 97, 298
Saliretine, 288
Saltpetre, Chili, iodine from, 225
Samarskite, 166
Sandberger, F., glaukopyrite, 90
isoclase and kollophane, 166
Sandstone-Lauden, 119
Sansom, A. E., theory of fermentation, 241, 254
Santorin earth, 144
Saponine solution, superficial viscosity of thin sheets of, 22
Saytzeff, A., conversion of primary normal butyl-alcohol into the secondary butyl-alcohol, or methyl-ethyl-carbinol, 76
Scarlet, pure, 190, 200
Schellbach, Dr., acoustical attraction and repulsion, 96, 191
Schellen, H., "Spectrum Analysis" (review), 284
Scheuer, C., glycerine, 154
Scheurer-Kestner, A., chlorhydric acid upon osseine, 107
composition of crude soda, 267
estimation of nitrates in potable waters, 94
gaseous products of combustion of coal, 22
naphthylamine violet, 120
Schickendantz, F., ccollpa, 202
Schiebler, C., calcimeter, 75
raw sugar which contains dextrine, 215
Schiff, H., amygdalin and amygdalinic acid, 83
carbanilidic acid ether, 130
constitution of arbutine, 35
constitution of phloridzine, 287
Schilling, N., new project of water supply for Berlin, 287
proceedings of tenth annual meeting of gas engineers and gas-works' managers in Germany, 203
tin-lined lead tubing, 168
water supply in Paris, 287
Schistose rock, 69
Schlebusch, W., on the camphor group, 83
Schlœsing, Ch., precipitation of muddy matter from water by the aid of dilute saline solutions, 21
Schmidt, Dr. C., derivatives obtained from normal propylic alcohol, 323
E., action of phosgen upon some of the amides, 144
E. A., chromate of protoxide of nickel, and on double chromate of protoxide of nickel and ammonia, 287
Schmitt, R., and H. von Gehren, fluorbenzoic acid fluorbenzol, 24
Schneider, R., new sulpho-salts, 192
Schonn, Dr., sodium a flux for minerals, 224
Schorlemmer, C., cetyl-alcohol, 84
hexyl-hydride, 84
Schotländer, P., two metallic derivatives of glycerine, 178
Schott, Dr., crystallisation of iron and steel, 94
Schrader, F., fires in pine forests, 119
Schrank, L., amido-sulpho-phenol, 215
Schulze, E., cholesterine in suint, 226
Schultz-Sellach, C., action of phosphuretted hydrogen upon zinc ethyl, 299
iodine, colours exhibited by, 96
Schmulewitsch, S., effects of heat on elasticity of caoutchouc, 95
Schützenberger, P., madder for use in calico printing, 191
action of iodide of cyanogen upon oil of turpentine, 107
phospho-platinic compounds, 22, 34, 191
platinum compounds, 107
solubility of oxygen in molten silver, 191
Schwanert, H., toluylen oxide, 167
Schwarz, E., homologues of isethionic acid, 153
H., abnormal behaviour of Mahrenberg magnesite, 274
manufacture of chromate of potash, 274
decomposition of chloride of potassium by sulphate of magnesia, 275
gold, platinum, and silver, as applicable to ornamentation of porcelain, glass, and other substances, 155
wocheinite, 274
Schwend, E., opium from papaver plants, 192
Schwind, F. R., apparatus for exhausting substances, 274
Science among the ancients, 72
teaching free, 36
Scientific relations, international, 108
Scorpions, venom of, 143
Scott, Wentworth I., solubility of tin in nitric acid, 321
Sea-sand fit for platinum crucibles, method of obtaining, 275
Secchi, Father A., S. J., inclination of the axis of the basilica of St. Peter, at Rome, 59
recent observations on spectra of various types of stars, 70
the sun, 106
Seeley, C. A., solvent power of anhydrous liquid ammonia, 217
Selenium, chloride of, action of ammonia on, 226
Selenka, E., morphology of the shoulder muscles of birds, 71
Senhofer, C., bromo-phenol-sulpho acids, 288
Serena, F., chromic chloride, 83
Sewel, A., hygienic vinegars, 94
Sestini, F., metallic benzoates, 48
Sewage question, 289, 301
utilisation of, 148
Seyfferth's, Dr., purification of syrups and molasses, 248
Sharples, S. P., precipitation of antimonous sulphide from boiling solutions, 190, 259
Shepard, C. U., ambrosine, 71
mineralogical contributions, 96
Siersch, A., testing value of opium, 227
Signals, luminous, visible at great distances, 58
Silica, absorptive properties of, and hydration with water, 236
Silica and artificial stone, 195
Silicates, analysis of, 240
Siliceous minerals, estimation of ferrous oxide in presence of ferric oxide in, 2
Siliceous substances, pyrometric value of, 83
Silicic acid in aqueous solutions, 83
Silicium, sulphur, and phosphorus, estimation of in pig-iron, 144
Silico-propionic acid, 22
Silk, black, spontaneous combustion of, 144
Silliman, B., determination of photometric power of a rich gas by dilution with a poor gas of known value: the "method of mixtures," 323
Mr. Stimpson's paper on Farmer's theorem, 323
J. M., examination of Bessemer flame with coloured glasses and spectroscope, 313
Silva, Dr., action of silver upon monochlorhydrine, 191
Silver diglycolamide, nitrate of, 287
Claudet's process of extraction, 184
German, 84
mine of Potosi, 119
molten, solubility of oxygen in, 191
Sirks, J. L., compensation of an optical change of phase, 227
Skey, W., absorption of sulphur by gold, and its effect in retarding amalgamation, 282
absorptive properties of silica, and hydration with water, 236
carbonate of lime, alkalinity of, 85
extraction of poisonous principle of tutu plant (Coriaria ruscifolia), 314
fusibility of platinum in the blow-pipe flame, 268
hot-blast for blowpipe purposes, 103
iodine and bromine for detecting gold, 245
production of certain crystalline phosphates and arseniates, 61
Skin, composition of, 155
permeability of for liquids, 144
Slater, J. W., "The Manual of Colours and Dye Wares: their Properties, Applications, Valuation, Impurities, and Sophistications" (review), 43
Smith, Dr. Angus, F.R.S., "Alkali Act: Annual Report" (review), 165
J. Lawrence, description and analysis of a meteoric stone that fell in Stewart County, Georgia, U.S., 323
alkalies contained in leucite, 13
"Paris Universal Exposition, 1867: Reports of the United States Commissioners" (review), 68
potash salts from sea-water, 112
practical remarks on use of flame-heat in chemical laboratory, especially that from burning gas, without aid of a blast, 323
precipitation of cæsium and rubidium salts with the insoluble salts of lime, 150
W., iso-dinaphthyl, 296
Smoke and coal consumption, 24
Smoke-consuming furnace, 108
Snake poison and its antidote, 179
Soap making, 168, 180
Soda, acetate of, carbonic and alcoholic fermentation of, 34
and oxide of copper, double phosphate of, 288
crude, 21, 267
hyposulphite, new use for, 95
nitrate, iodine from, 225
used in the metallurgy of nickel and soda, 83
sulphate of in carbonate of, 83
tungstate of to form an elastic mass, 215
Sodic sulphate, action of nuclei on supersaturated solutions of, 242, 253, 265
Sodium as a flux for minerals, 224
loss of in Le Blanc's process, 21
in soda works, 33
potassium, and ammonium, composition of acid-oxalates of, 14
reversal of the two lines of in spectrum of light produced by a solar protuberance, 21
Soil, peculiarities of the Landes, 69
Sokolnicki candles, economical, 95
Solar Corona and Aurora as electric phenomena, 294
protuberances, reversal of sodium lines in, 21
spectrometry, 199, 205
spectrum, 82
temperature, 96
Solubility of tin in nitric acid, 322
Solutions, general doctrine of, 25
historical note on, 52
supersaturated, 87
Sondhauss, Dr. C., sound emitted by tubes, 35, 93
Sonelén, Dr., detection of salicine in quinine, 144
Sonnenschein, Dr., application of tungstate of soda to form an elastic mass, 215
compounds of cerium, 130
Sonstadt, E., rubidium and cæsium, 25, 44
Sorbinic acid, 202
Sorokin, W., behaviour of some of the haloid compounds of ethylen and propylen with hydriodic acid, 299
Sound emitted from heated tubes, 35, 95
Sourdat, L., unequal production and difference of composition of the milk of the breasts of the same woman, 34
Sonrel, L., photographical studies of the sun at the Imperial Observatory at Paris, 58
Specifications relating to aëronautics, abridgments of, 44
Specific gravity of alcohol, 71, 191
heat of the aqueous solutions of chemical compounds, 154
of saline solutions and mixtures of liquids, 191
heats and co-efficients of any substance, relation existing between, 93
Speck, H., drainage, its bearing upon the water supply, 203
Spectra, existence of two produced by carbon incandescent at the same temperature, 172
of erbia and other earths, 175
of stars, 70
Spectroscope applied to Bessemer process, 44
examination of Bessemer flame with coloured glasses and, 313
for laboratory, 229
in water-analysis, 322
in which the prisms are automatically adjusted for the minimum angle of deviation, 222
Spectroscopic notes, 218, 277
"Spectrum Analysis, its Application to the Matter of the Earth and to the Elucidation of the Nature of the Heavenly Bodies" (review), 284
apparatus, use of for light absorption, 35
of the aurora, 225
of light produced by a solar protuberance, reversal of the two sodium lines in the, 21
of solar atmosphere, 82
Spence, J. B., phenomena of crystallisation of double salt, 181
Spice, R., magnetic power by a galvanic battery, 271
Spielhagen, T., gas meters, 168

Spiess, Dr., behaviour of permanganate of potassa with sulphuric acid, 24
Spiller, J., discrimination of fibres in mixed fabrics, 169
Church's stone preserving process, 224, 250, 285
Spirgatio, Dr., on resin contained in the tampico-jalap, 288
Spirit made from moss and lichens, 23, 144
Sponges of the White Sea and Arctic Ocean, 154
Spontaneous combustion of black-dyed silk, 144
Stahlschmidt, Dr., preparation of spirits from lichens, 23, 144
Stamkart, F. J., simple method for the exact and precise comparison of measures of length, 72
Stanford, E. C. C., marbles from Tyree, 171
retention of organic nitrogen by charcoal, 183
the sewage question, 289, 301
Stanno triethyl, 130
Starch and alcohol, 180, 192
adulterated, 214
Stars, spectra of, 70
Stassfurth and its industry, 192
Steam boiler explosions, 179
filter pump, 163
Stearine, 179
Stenberg, T., spirit from moss and lichens, 144
Stebnitzki, J., deviation of plumb-line, caused by attraction of the Caucasian mountains, 154
Steel for engines and machinery, 179
Indian composition of, 46
and iron, crystallisation of, 94
types, manufacture of, 118
Stein, W., sulphide of carbon decomposed by heat, 312
Stellarton acid-water, analysis of, 12
Stenhouse, J., nitro-substitution compounds of the orcins, 98
Stimpson, F.E., Farmer's theorem discussed, 323
Stolba, F., acid nature of organic matters in river water, 275
analysis of alabaster glass, 275
peat-ash, 275
behaviour of silico-fluoride of potassium with blowpipe flame, 275
crystallisation of chlorate of potash by fusion, 275
extracting indium from zinc-blende, 312
hydro-fluosilicic acid, 179
loss of weight occasioned by continually heating platinum crucibles, 275
precaution to be taken when paraffin is used to prevent liquids from boiling over, 275
reduction of tellurous oxide by grape sugar, 312
testing for cæsium as double chloride of tin and cæsium, 312
testing graphite, 311
Stölzel, C., earthen- and crockery-ware which is injurious to health, 154
Stone, preservation of, 224, 238, 250, 273, 285
waterproofing, 286
Storer, F. H., "Cyclopædia of Quantitative Analysis," 297 (review)
properties and estimation of albumen, 62
quantitative analysis, examples for practice, 89, 99, 109, 163, 187
Strecker, Dr., strychnine oxethyl compounds, 226
sulpho-maleinic acid, 226
uroxanic acid and uric acid, 178
Streets, watering with saline solution, 47
String of musical instrument, vibrations of, 96
Strune, Dr. O., conference on the prototype metre, 120
Strychnia colours, test for detection of, 178
detection of in medico-forensic analysis, 143
Strychnine or ethyl compounds, 226
Stur, D., dyas and coal formation in the Banate, 202
Sulphaldehyd of the ethyl series, 83, 287
Sulpho-acids and sulpho-hydrates derived from crystallised bromotoluol, 144
Sulphobenzoic acid, 213
Sulphocarbonyl-chloride, 312
Sulphomaleinic acid, 226
Sulpho-salts, 192
Sulphotoluide, 35
Sulphur, absorption of by gold, 282
action of chloride of upon aniline, 59
chlorides of, 226
in coal-gas, 203, 307
deposit, new, 178
organic compounds, preparation by means of hyposulphite of sodium, 35
phosphorus, and silicium, estimation in pig-iron, 144
solubility of in aqueous solution of carbonate of soda and in linseed oil, 214
spectroscopic reactions of, 191
thermical researches on, 168
Sulphurets, 82, 83
Sulphuric acid, 23, 24, 192, 204
action of on diallyl, 221
manufacture and condensation of the nitrous vapours in, 225
molecular heat of hydrates of, 214
organic chlorides which contain nitrogen, 213
sulphurous acid, detection of, 70
Sugars, estimation of glucose in, 120
Suint, cholesterine in, 226
Sun, the, 106
photographical studies of, 58
physical constitution, 24
Sun-dial, 70
Suringar, W. F. R., new species of argostemma, 71
Survey and levelling in Switzerland, 167
Süvern disinfectant, 107
Swedenborg on solutions, 25
Syphons, 60
Syrups, purification of, 248, 261, 273

TABACHERE, 216, 228
Talbott, J. H., new analytical process, 190, 229
quantitative separation of tin and tungsten, 190
Tannic acid, methods for its determination in catechu, ratanhia, kino, &c., 216
preparation of, 251
Tannin, fermentation of in tan pits, 155
Tar colours, poisonous action of, 107
soluble vegetable, 118
Tarry, H., dust and blood-rains, 22
Tarry matter from gas-water, 312, 324
Tartaric acid, prevention of mouldiness in aqueous solutions, 13
and citric acids, estimating, 228, 240
and malic acids, 107
Tate, W., phosphate of lime, 228
Tawildarow, N., on xylol, 202
Taylor, A. B., new sulphur deposit, 178
Teichmann, H., hydrate of protoxide of nickel, 287
Tellurous oxide, reduction by grape sugar, 312
Temperature compensating with the weighing or balance barometer, 154
constant in laboratory operations, 225
reduction of annual curves of, 287
underground in the Jardin des Plantes at Paris, 58
variations of, produced by the mixing of two different liquids, 21, 34, 58
Tension, superficial, of liquids, 35
Terebratula diphya in calcareous rock, 70
Test-paper, preparation of ultramarine, 286
Tetroxide, reaction between water and nitrogen, 286, 311
Thallium, 60, 179
Thau, C., formation of ozone during active combustion, 24
Thermal spring, analysis of water of, 178
Thermical researches on metallic character of the alloy of palladium with hydrogenium, and on a voltaic element wherein hydrogenium is the active metal, 58
Thermo-chemical researches, 35, 82, 227
Thermo-mineral water, 95
Thiern, A., water yielded by artesian wells, 168
Thihydrobenzoic and dithiobenzoic acid, 23
Thionyl, chloride of, action of ammonia on, 226
Thiophenol, conversion into phenyl-bisulphide, 55
Thomsen, J., beryllium of platinochloride, 263
evolution of heat ensuing on mixing water and sulphuric acid, 47
silicic and hydrofluoric acids in aqueous solutions, 83
specific heat of the aqueous solutions of chemical compounds, 154
thermo-chemical researches, 35, 227
Thorey, E., nitrogen in black and white henbane, 215
Tichborne, C. R. C., alkalinity of carbonate of lime, 150
dust as a ferment, 197
"Tiers argent," alloy known as, 225
Tilloy, M., Pindray's smoke-consuming furnace, 108
Tin, after exposure to cold, 22
alloy of with manganese, 194
dimorphism of, 154
dissolved by nitric acid, 298
isotrimorphism of oxide of, 215
solubility of in nitric acid, 322
and tungsten, quantitative separation of, 190
Tin-lined lead tubing, 168
Tissandier, G., rain-water, 108
Titanic acid, isotrimorphism of, 215
Toluidine, action of nitric acid on, 155
Toluol, new derivatives from, 144
Toluol-sulpho-acids, 70
Toluylen, oxide, or desoxy-benzoine, 167
Tollens, B., allyl-cyanide, 144
conversion of allyl-alcohol into normal propylic alcohol, 226
Tomlinson, C., functions of nuclei with respect to supersaturated saline solutions, 97, 109, 265, 280
historical note on solutions, 52
Topsöe, H., hydrates of platinic acid and platinate of barium, 47
Toselli, M., artificial ice, 119
Tremellat, J. B. F., preservation of grapes in the fresh state, 180
Trémont annual prize, 46
Tresca, M., water-meter, 72
system of water-wheels, 34
Tribromhydrines, 21, 84
Trichloro-acetic acid and trichloro-crotonic acid, 214
Tridymite, microscopically small, 191
Triethyl-phosphine, new derivatives from, 22
Trimethyl-carbinol, conversion of butyl-iodide and butylamine of fermentation into, 83
Trinkerite, fossil resin, 202
Trommer, Dr., preparation of condensed milk, 275
Tschermak, Dr., meteorite of Lodran, 72, 96
Tungsten and tin, quantitative separation of, 190
Turkey red, 288, 324
Turmeric root, 84, 96
Turpentine oil, iodide of cyanogen, 107
Tuson, R. V., remarks on ricinine, 229
Tutu plant (Coriaria ruscifolia), extraction of poisonous principle of, 314
Tyndall, Prof., electrical phenomena and theories, 67, 105, 113, 150

ULEX, M., sulphur in coal-gas, 203
Ultramarine test-paper, 286
Uratonil, 214
Urea in bile, 288
Uroxanic acid and uric acid, 178

VACCINE lymph, vitality of, 167
Vaccinine, 71
Vanadiolite, 60
Vapour, density of acetic acid, 154, 202
of perchloride of phosphorus, 106
Vapours, physical properties of, 35
and gases, indices of refraction and measurement of their dispersion, 35
Vauquelinite and laxmannite, identity, 60
Venom of scorpions, 143
Ventilator, aspirating, 60
Veriot, E., coke from non-caking coals, 191
Vibrations, elastic, 96
standing, 96
Vierordt, C., measurement of the absorption of light by transparent media by means of the spectrum apparatus, 35
Villarcean, Y., decimal division of angles and time, 10 6
Vellari, E., acoustical studies of flames, 227
Vinage, 60, 83
Vincent, C. W., apparent parallels to regelation, 313
Vine leaves and cuttings of young vine twigs, utilisation of, 94
Vinegars, hygienic, 94
Violet, naphthylamine, 120
Violette, M., painting by means of injection, 59
Viscosity, superficial, of thin sheets of saponine solution, 22
Vogel, Dr., changes of the colour of flowers when exposed to ammonia gas, 239
A., chemical investigation of Bohemian lager beer, 108
H., properties of the images produced by photographic lenses, 191
Vogelsang, H., crystallites, 71
Vogt, E., non-existence of chlorcyanhydrogen, 178
Vohl, H., injurious and poisonous action of tar colours, 107
poisonous substances in bread, 215
tallow melting, 240
Volatilisation, temperature of, 71
Volcanic eruptions, part gases play in, 119
Volhard, J., foundation o chemistry, 96

Volpicelli, P., property of volta-electrical condenser, hitherto unnoticed, 34
Voltaic decomposition apparatus, 188
Völter's wood-shaving and pulping machine, 23
Volumetric analysis, 66
estimation of iron, 71, 72, 313
of soluble fluorides, 70
Vorwerk, Dr., morphia from the capita papaveris albi, 262

WABNER, R., steam boiler explosions, 179
Wagner, A., behaviour of sulphuret of zinc exposed to air, 179
O., application of the ash and small coke of gasworks for brickmaking, 36
R., formation of graphite, 275
use of nitrate of soda in the metallurgy of nickel and soda, 83
Walenn, W. H., electro-deposition of copper and brass, 1, 181
Wallach, O., mono-bromotoluol, and derivation of isomeric amido bases from a hydrocarbon, 82
nitration of naphthol, 312
Walz, J., extinction and reducing power of mercury, 217
Wartha, V., alizarine, 130
anthracen pigments and preparation of anthracen in pure state, 59
Warbury, E., passage of mercury through glass capiliary tubes, 191
Water, action of upon iron, 34
analysis, 153, 214
spectroscope in, 322
bath, continuous, 42
caloric, capacity of when near its greatest density, 227
clarification of, 21
crystal, 239
of crystallisation, 215
dirty, purification of, 95
evaporated by an oak tree, 239
evaporation and decomposition of carbonic acid by leaves of plants and trees, 35
glass, reactions of, 263
solution, 239
hammer, luminosity of, 239
Water, hard and soft, 168, 204
meter constructed by M. Chameroyfils, 72
of the Nile, 202
potable, nitric acid in, 227
river, filtration, 72, 84
supply of Paris and Berlin, 287
of towns, 107
weight of a cubic decimetre of, at 4° C., 154
wheels, report on, 34
works of Berne, 203
Waterproofing, 72
Watts, W. M., calorific power of Hare's blow-pipe, 217
existence of two spectra produced by carbon incandescent at the same temperature, 172
temperature and heating powers of flames, 116
Wax, bleaching, 192, 204
in opium, 130
vegetable, composition and occurrence, 58
Wedding, Dr., zinc for desilverising lead, 311
Weights, aluminium, 187
Weineck, J., double phosphate of oxide of copper and soda, 288
Weinhold, A., observations on induction sparks, 35
Weiss, M., stearine manufacture, 179
Weldon, W., manufacture of chlorine, 145
Wells, T., extract of meat, 36
Wenzell, W. T., colour test for detection of strychnia, 178
Werigo, A., action of pentabromide of phosphorus upon azoxybenzide, 144
Werner, E., ricinine and ricinus seeds, 203
Wernicke, W., peroxides of metals obtained by electrolysis, 240
Weselsky, P., chinons, 130
West, M., volumes of the chemical equivalents, 107
Wetherill, C. M., note on itacolumite, 265
Weyrich, Dr., detection of strychnia in medico-forensic analysis, 143
White, W., Mr. Beswick and Swedenborg, 45
pigments, an improved method of producing from lead, 45
Whitwell, heating the air of hot-blast furnaces, 179
Wichelhaus, H., acetyl-derivatives of ammonia, 312
nitration of naphthol, 312
Wiederhold, Dr., composition of Chinese lacquer-work, 119
Wild, H., weight of a cubic decimetre of water at 4° C., 154
Williamson, A. W., F.R.S., fermentation, 234, 247, 258, 268, 292, 304, 316
Williigen, V. S. M., Holtz's electrical machine, 72
Wines, vintage, 36
Winkler, C., alloy known as "tiers argent," 225
chlorimetry, 274
Witte, Dr., specific heat of the air under constant pressure and volume, 227
Wittich, V., diastatic ferments, 167
Wittstein, Dr., carbon in iron, 311
Wittenstein, E., cyan-benzidine, 154
Wocheinite, 274
Woestyn, C., centrifugal mixer, 60
movable rotating gas-burner producing a helicoidal flame, 59
Wöhler, F., analysis of pyrosmalith, 288
German silver, 84
Wolff, J., Stassfurth and its industry, 192
Wolkow, A., isomeric toluolsulpho acids, 70
Wolters, W., lime and cement, 22
mortar, 226
Wood, drying of, 263
W. H., prevention of mouldiness in aqueous solutions of tartaric acid, 13
Woodward, C. J., voltaic decomposition apparatus, 188
Lieut.-Col. J. J., oxycalcium light, as applied to microphotography, 323
Woody fibre for paper, 23, 83
Woollen fabrics, drying of, 120
Wootz or Indian steel, composition of, 46
Wright, C. R. A., loss of sodium in soda-works, 33
Wrinkle, L. F. J., simultaneous precipitation of alumina and magnesia by ammonia, 4
Wullner, A., specific heat of saline solutions and mixtures of liquids, 191
Wunder, G., formation of crystals in beads of borax and phosphor-salt when formed before the blowpipe-flame, 60
isotrimorphism of oxide of tin and titanic acid, also the crystalline form of zirconia, 215
Wurtz, A., solid cresol, 107
Dr., vapour density of perchloride of phosphorus, 106
H., calorific power of Hare's blowpipe, 207
temperature and heating power of flames, 102

XYLOL, 202

YEAST, vitality of, 167
Young, Prof. C. A., photograph of a solar prominence, 323
solar spectrometry, 199
spectroscopic notes, 218, 277
Yttrocerite, 312

ZALIWSKI, M., gunpowder prepared with chlorate of potassa, 143
Zentmayer, J., new mechanical finger for the microscope, 55
Zinc, alloy of, with manganese, 194
deposited on copper or brass, 108
for desilverising lead, 311
sulphocarbonate of, 276
sulphuret, exposed to air, 179
Zinc-blende, extracting indium from, 312
Zinc-ethyl action, 311
of phosphuretted hydrogen upon, 299
Zinc-methyl, action of phosgen on, 299
Zirconia, crystalline form of, 215
Zirconium, 23
Zundnadelgeweter, improved, 179

END OF VOLUME XXII.

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